RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY
Vol. III
(1964-1965)

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BIBLIOGRAPHICAL SERIES No. 24

RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY
VOL.III
(1964-1965)

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VIENNA, 1967

RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY -VOL.III (1964-1965)
(Bibliographical Series, No.24)

ABSTRACT. This bibliography is the third volume of a series and contains over 1000 references to the literature for the two-year period 1964-1965. The first two volumes, Bibliographical Series Nos. 9 and 15, cover the 11- and 3-year periods 1950-1960 and 1961-1963, respectively. The bibliography is fully annotated and abstracts have been included whenever possible. Tables give a systematic list of insects and related arthropods, sterilization data, lethal radiation effects, and radioisotope tracer studies on insecticides. An author index, a detailed subject index, and an insecticide index are provided.

The bibliography was compiled by Mrs. M. Binggeli of the Division of Scientific and Technical Information, IAEA.

(454 pp., 16 × 24 cm, paper-bound) Price: US $9.50; £3.7.0
(1967)

BIBLIOGRAPHICAL SERIES, No.24: RADIOISOTOPES AND
IONIZING RADIATIONS IN ENTOMOLOGY (1964-1965)
IAEA, VIENNA, 1967
STI/PUB/21/24

FOREWORD

The present bibliography on Radioisotopes and Ionizing Radiations in Entomology represents the third volume of a series, and covers the years 1964 and 1965. More than 1000 references have been assembled for that 2-year period alone. Earlier volumes covered the 11- and 3-year periods of 1950-1960* and 1961-1963**, respectively. This bibliographical series, which covers the world literature, will be continued and the next volume is scheduled for 1968.

The bibliography is again fully annotated, and abstracts have been included whenever possible. The bibliography has certain unusual features: 1) The detailed Subject Index contains a routine indication for individual reference citations, of the particular radioisotope or radiation used, and a condensed notation for additional information. 2) Numerous tables have been compiled: (a) a systematic table of references listed by order, family, genus, and common names of the insects studied; (b) summarized data on sterilizing and lethal doses; (c) tracer work in the insecticide field, with two separate insecticide indexes.

The documentation will be of practical use to the specialist requiring a rapid survey of relevant publications in related disciplines, to someone in search of detailed documentation on a particular aspect of the field, and to the scientist in developing countries whose access to the world literature might be somewhat limited.

The bibliography was compiled by Mrs. M. BINGGELI of the Agency's Division of Scientific and Technical Information.

Readers are invited to address their suggestions and other correspondence regarding the "Bibliographical Series" to: The Director, Division of Scientific and Technical Information, International Atomic Energy Agency, Kärntner Ring 11-13, A-1010 Vienna, Austria.

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* Bibliographical Series No. 9
** Bibliographical Series No. 15

AVANT-PROPOS

La présente bibliographie, concernant les radioisotopes et les rayonnements ionisants en entomologie, est le troisième volume d'une série consacrée à cette question; elle porte sur les années 1964 et 1965. Elle contient plus de 1000 références pour cette seule période de deux ans. Les deux volumes précédents portaient respectivement sur des périodes de 11 ans (1950 à 1960)* et de trois ans (1961 à 1963)**. L'Agence poursuivra ce travail bibliographique touchant la documentation publiée dans le monde entier; le prochain volume doit paraître en 1968.

Cette bibliographie est entièrement annotée et contient, dans la mesure du possible, des résumés analytiques. Elle présente certaines caractéristiques: 1) dans l'index par sujets, les sujets sont groupés sous des mots-clés et suivis, non seulement d'un renvoi au corps du document, mais aussi de la mention du radioisotope ou du rayonnement utilisé; 2) on a établi plusieurs tableaux: a) un tableau systématique des références classées selon l'ordre, la famille, l'espèce et le nom vulgaire des insectes étudiés; b) des données succinctes sur les doses de stérilisation et les doses létales; c) travaux à l'aide de radioindicateurs sur les insecticides, avec deux index des insecticides.

Cette documentation aura une valeur pratique pour les spécialistes désireux de trouver rapidement une liste des publications dans les domaines qui les intéressent, pour toute personne cherchant des références détaillées sur certains aspects particuliers de la recherche entomologique et pour les hommes de science des pays en voie de développement qui éprouvent des difficultés à se procurer les publications parues dans le monde.

Cette bibliographie a été établie par Mme M. BINGGELI, de la Division de la documentation scientifique et technique de l'Agence.

Les lecteurs sont priés d'adresser leurs suggestions et toute la correspondance concernant la « Collection Bibliographies » au Directeur de la Division de la documentation scientifique et technique, Agence internationale de l'énergie atomique, Kärntner Ring 11-13, A-1010 Vienne, Autriche.

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* Collection Bibliographies n° 9.
** Collection Bibliographies n° 15.

ПРЕДИСЛОВИЕ

Настоящая библиография является третьим томом серии, посвященной использованию радиоактивных изотопов и ионизирующих излучений в энтомологии. В нее вошло более 1000 ссылок на литературу, опубликованную в 1964 – 1965 гг. Предыдущие выпуски относятся к 1950 – 1960 гг.* и 1961 – 1963 гг.** Работа по выпуску этой серии, охватывающей материалы, опубликованные в разных странах мира, будет продолжена; издание следующего тома запланировано на 1968 г.

Как и в первых двух томах, были приложены все усилия к тому, чтобы библиографические описания были как можно более информативными: каждая библиографическая справка содержит большое количество элементов, почти каждое описание – аннотацию. Отличительными чертами библиографии являются: 1) рубрики подробного предметного указателя содержат не только энтомологические понятия, но и радиоизотопы и излучения, которые приведены с указанием на номера библиографических описаний, в которых они упоминаются, и специальную нотацию, позволяющую быстро найти различные дополнительные сведения в библиографии; 2) многочисленные данные сведены в таблицы: а) систематическая таблица данных, классифицированных по отряду, семейству, роду и общепринятому названию насекомых, б) краткая таблица данных по стерилизующим и летальным дозам, в) таблица данных по исследованиям с изотопными индикаторами в области инсектицидов с двумя индексами инсектицидов.

Библиография рассчитана как на специалистов, работающих в смежной с рассматриваемой областью науки, для которых она может оказаться источником готовой экспресс-информации по интересующим их темам, так и на лиц, ведущих доскональный документационный поиск по какой-нибудь из проблем, являющихся предметом рассмотрения данного издания, а также на ученых развивающихся стран с ограниченными книжными ресурсами.

Библиография составлена сотрудницей Отдела научно-технической информации МАГАТЭ г-жой М.БИНГГЕЛИ.

Просьба все замечания, пожелания и предложения, касающиеся "Библиографической серии", направлять по адресу: Австрия, А-1010 Вена, Кернтнер-Ринг, 11 – 13, Международное агентство по атомной энергии, Директору Отдела научно-технической информации.

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* "Библиографическая серия", №9.
** "Библиографическая серия", №15.

PREFACIO

La presente bibliografía sobre el empleo de radioisótopos y radiaciones ionizantes en entomología abarca los años 1964 y 1965 y es el tercer volumen de la serie. Solamente para este período se recogen más de 1000 referencias. Los volúmenes anteriores abarcaban un período de once años (de 1950 a 1960)* y otro de tres años (de 1961 a 1963)**. Para 1968 está prevista la aparición de otro volumen de esta serie que contiene referencias a publicaciones del mundo entero.

Las notas bibliográficas dan todos los detalles posibles y en muchas ocasiones van acompañadas de resúmenes. Esta bibliografía tiene ciertas características nuevas: 1) en el detallado índice de materias se señala para cada referencia el radioisótopo o la radiación utilizados y se indican otros datos en clave; 2) se han compuesto numerosos cuadros: a) un cuadro sistemático de referencias según el orden, la familia, el género y el nombre común de los insectos estudiados; b) datos resumidos sobre dosis esterilizantes o letales; c) empleo de trazadores en materia de insecticidas, con dos índices distintos de insecticidas.

Esta bibliografía será de utilidad para los especialistas que necesiten un rápido análisis de las publicaciones importantes en materias afines a su especialidad, para las personas que busquen una documentación detallada sobre cuestiones determinadas y para los científicos de los países en desarrollo que a veces tropiezan con dificultades para obtener las obras publicadas.

Ha preparado la bibliografía la Sra. M. BINGGELI, de la División de Información Científica y Técnica del Organismo.

Se ruega a los lectores que envíen sus observaciones y la correspondencia relativa a la «Colección de Bibliografías», al Director de la División de Información Científica y Técnica, Organismo Internacional de Energía Atómica, Kärntner Ring 11 y 13, A-1010 Viena (Austria).

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* Colección de Bibliografías, Nº 9.
** Colección de Bibliografías, Nº 15.

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INTRODUCTION

COMPILATION OF BIBLIOGRAPHY AND GUIDE FOR ITS USE

SOURCES

The bibliography was compiled from the open literature. A first routine search consisted of scanning selected secondary sources:

(a) Abstracting journals

- Biological Abstracts (BA)
- Bulletin Bibliographique:
    - Isotopes. Rayonnements. Agriculture* (BB)
- Chemical Abstracts (CA)
- Dissertation Abstracts (DA)
- Nuclear Science Abstracts (NSA)
- Nuclear Science Abstracts Japan (NSA/J)
- Review of Applied Entomology,
    - series A: Agriculture (RAE-A)
    - series B: Medicine (RAE-B)

(b) Title listings

- Bibliography of Agriculture (BAg)
- Biological and Agricultural Index (AI)
- Bulletin Signalétique Hebdomadaire –
    - Périodiques de Chimie**
- Current Contents –
    - Chemical, Pharmaco-Medical & Life Sciences**
- List of References (STI/DOC/12, fortnightly***)

Subsequently, primary sources were scanned, abstracts being prepared where necessary, and references cited in original papers were followed up. Numerous books, conference proceedings, bibliographies, and reports were also scanned, including such review series as: A.Rev.Ent. 9 (1964), 10 (1965) (Smith, R.F., Mittler, T.E., Eds.); Adv. Pest Control Res. 6 (1965) (Metcalf, R.L., Ed.); "Genetics Today". 11th International Congress of Genetics, The Hague, Sep. 1963. Vol. 1-3. Geerts, S.J., Ed. Oxford, Pergamon Press, 1965.

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* Includes keywords but no abstracts.

** Lists tables of contents of variety of journals.

*** Current literature, including numerous reports, received routinely by the International Atomic Energy Agency.

Among the selected journals scanned routinely are:

Ann. ent. Soc. Am.
Atompraxis
Biochem. J.
Biochim. biophys. Acta
Bull. ent. Res.
Bull. ent. Soc. Am.
Can. Ent.
Can. Insect Pest Rev.
Can. J. Biochem.
Chromosoma
C.r. hebd. Scéanc. Acad. Sci. D
Dokl. Akad. Nauk SSSR – biol. Sect.
Ecology
Ent. Rev. (AEC-tr-Russian)
Experientia
Expl Cell Res.
Genetics
Hereditas
Int. J. appl. Radiat. Isotopes
Int. J. Radiat. Biol.
Int. Pest Control
Insectes soc.
Jap. J. appl. Ent. Zool.
  (Nihon Oyo Dobutsu Konchugaku Zasshi)
Jap. J. Genet. (Idengaku Zasshi)
J. agric. Fd Chem.
J. biol. Chem.
J. Cell Biol.
J. econ. Ent.
J. Insect Physiol.
J. molec. Biol.
Mosquito News
Mutation Res.
Nature, Lond.
Nucleonics
Pesticide Prog.
Radiat. Res.
Radiobiology (AEC-tr-Radiobiologyia)
Science, N.Y.
Z. Naturf.

The omission of an abstract for a given reference may be due to one of the following reasons:

(1) the reference had originally been obtained from a title listing or quoted in a publication which had subsequently proved impossible to obtain for consultation;

(2) the contribution had appeared in an interim form intended for limited circulation only, where permission could not be obtained for quoting details of essentially unpublished work at a preliminary stage or pending publication elsewhere; and

(3) summaries of projects and research under contract are largely outdated by the time the bibliography appears in print, much of the results having been published in the literature by then.

Such references have, nevertheless, been included as title citations and appropriately indexed since some readers might wish to follow them up by establishing direct contact with the scientists concerned (cf. Author Index: Affiliations).

Reports

Numerous reports have been abstracted, and may be considered valuable as indicative of trends in the particular field or institution.

REFERENCES

References are arranged according to subject matter as laid out in the Table of Contents. Articles reviewing the particular subject or of a general or introductory nature are placed at the beginning of a section. Such reviews are more specific than those contained in the Addendum (B. Bibliographies and General Surveys), where broad fields are surveyed.

References published prior to 1964 but not included in the preceding bibliographies are marked by an asterisk. Where new data have been obtained on references included in Vols.I or II, these are given under their original number preceded by the volume number; e.g. reference x in Vol.II becomes II/x, and an abstract may thus be added to a reference originally cited by title only. This is of interest to users who own the preceding volumes as well.

References to work published prior to 1964 which had been omitted in the preceding volumes of the bibliography are marked by a superscript [(1) or (2)] next to the reference number, to indicate the appropriate volume [Vol.I covers 1950 to 1960, Vol.II 1961 to 1963].

Cross-References

These are cited at the end of each section, giving the title (in English only), first author, year of publication, and the reference number. Despite the very detailed Subject Index, cross-referencing has been used extensively.

ADDENDUM

Techniques

Some selected papers representative of particular techniques (e.g. autoradiography, neutron activation analysis, etc.) have been grouped together.

TABLES

Four Tables have been compiled.

Table 1. Systematic Listing of Insects and Related Arthropods

The insects and related arthropods cited in the bibliography are grouped together systematically by order, family, genus, and common name*. Their place in this table is also indicated in the Subject Index where the systematic code appears next to the scientific name**.

Table 2. Sterilization Data

Data are summarized on the radiation-induced sterilization of 32 species of insects, also listing the insect (by order, family, generic and common name), the stage irradiated, the dose and radiation used, and where possible the efficacy of the technique.

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* Based on the scientific and common names listed in Bull. ent. Soc. Am. 11, 4 (1965).

** Itself traceable via the common name, if the scientific name is not known.

Table 3. Lethal Radiation Effects

Data on lethal radiation effects are listed for 16 species, laid out as in Table 2.

Table 4. Radioisotope Tracer Studies in Insecticides

This table gives a digest of radioisotope tracer studies on insecticides. Chemical names and other designations are indicated throughout. The particular radioisotope used in an analysis or synthesis as well as the animal, plant or particular substrate used in metabolid and residue studies are given. The insecticides have been grouped in certain broad categories which have also been maintained in the two Insecticide Indexes.

INDEXES

Insecticide Indexes

To facilitate checking on an insecticide, e.g. where a synonym has been used, the following two indexes have been compiled:

(i) Common and Manufacturers' Names Index
(ii) Letter and Name Index

to be used in conjunction with Table 4.

Author Index

As far as possible, up-to-date affiliations have been indicated for each author. Sole or first authors, in cases of joint authorship, have been indicated by underlining the pertinent reference number.

A Corporate Author Index is included.

Subject Index

A detailed Subject Index is provided. The radioisotopes or radiations used are indicated for each reference. The following convention has been adopted concerning the position in which they are cited with regard to a particular study: When the radioisotopes or radiations represent the cause they precede the phenomenon; when used as a tool for analysing existing conditions they follow the phenomenon studied. Irradiation, when combined with other modifying treatments (gaseous environment or temperature at irradiation, etc.) is quoted as radiation/treatment. When a comparison between radiation and other treatments (e.g. chemosterilant) is made, a comma is used to indicate this, e.g. x, tepa: ... Further illustrations are given below.

Radioisotope	Radiation
^{14}C: mutagenic effects: 109 (genetic effects incurred through use of ^{14}C)	γ: ovary: 637 (effects of γ-irradiation on organ studied)
	γ: sexual agressiveness, ♂: 905 (actual effects produced by γ-irradiation)
	x/O: longevity: 882 (-/ ... = additional experimental factor, introduced before, during or after x-irradiation)
	x, alkylating agents: 744 (-, ... = comparison between the effects of different treatments)
trehalose biosynthesis, ^{14}C:45 (biosynthesis traced [not effected] by ^{14}C)	habits, x: 1045 (habits of infesting insect detected and studied [not influenced] by using x-rays)

This convention enables the reader to obtain at a glance quite a considerable amount of information about a particular study.

In addition, as much other detail as possible has been condensed in the Subject Index, to include, wherever possible, information on the insect stage (in brackets) used, the tissue (in brackets), and the particular compound or process studied. Details of the energy or mode of irradiation are sometimes indicated.

GLOSSARY

The desirability of some form of shorthand notation to make the Subject Index a more potent source of condensed information has been evident for some time. A number of abbreviations, most of them self-evident, has therefore been used and will be listed below, to eliminate possible sources of error and for future reference.

α	alpha radiation
(a)	adult
ATP	adenosine triphosphate
β	beta radiation
CNS	central nervous system
(c)	cocoon
DNA	deoxyribonucleic acid

e	electrons
(e)	egg
EM	electron microscop(y) (ical findings)
(emb)	embryo
γ	gamma radiation
(ℓ)	larva
(ℓ5)	5th larval instar
n	neutron radiation
n_f	fast neutrons [when energy is specified suffix is dropped]
(n)	nymph
NA	nucleic acids
OP	organophosph(orus)(ate) [underlined to avoid confusion with elements]
(p)	pupa
(pp)	prepupa
(Dp)	Dauerpupa
R-	resistant (strain)
Rev.	Review
RNA	ribonucleic acid
mRNA	messenger RNA
tRNA	transfer RNA
S-	susceptible (strain)
I/120	Vol.I, reference 120
II/42	Vol.II, reference 42

ACKNOWLEDGEMENTS

The compiler (MB) of the bibliography is greatly indebted to Dr. L.K. Cutkomp, of the Joint FAO/IAEA Division of Atomic Energy in Agriculture, for active help, discussions and advice throughout, and to Dr. H.E. Erdman for checking the tables on radiation data. Professor W. Kühnelt, of Vienna University (Institute of Zoology), very kindly assisted in identifying the place of certain species in the systematic table.

I

RADIOISOTOPES

A. INSECT LABELLING

1. Methods

1 Andreev, S.V., Molchanova, V.A., Martens, B.K., Rakitin, A.A. RADIOMARKING IN THE STUDY OF INSECT PESTS. Vest. sel'khoz. Nauki, Mosk. 9, 2 (1964) 122-28. (In Russian, with English, German, and French summaries)

A laboratory method which was developed for labelling insects with radioactive isotopes was used under experimental conditions in order to define more precisely a number of problems concerning the biology of large numbers of parasites of the grain bug (Hemiptera: Eurygaster) and the grain moth (Hadena basilinea). Some new data were obtained on the sizes of the migrations of the grain bug during its larval and adult stages of development. A method for self-marking was worked out for the marking of H. basilinea adults. This method can be widely used in the study of the biology of other insects having positive phototaxis and chemotaxis; this method is especially valuable for marking Lepidoptera. (From translated auth. summary)

2 Chatterji, S., Sethi, G.R., Bhamburkar, M.W., Deshmukh, M.G. LABELLING OF ADULTS OF Chilo partellus Swinhoe. (C. zonellus). THE STALKBORER OF MAIZE AND "JOWAR", WITH RADIOACTIVE PHOSPHORUS (P^{32}). Curr. Sci. 33, 21 (1964) 652-3.

Fully formed caterpillars of C. partellus were starved for 17 h, then fed fresh maize stems treated with ^{32}P. These caterpillars were allowed to feed for 2 h and were washed thoroughly with water to remove surface contamination and then assayed for radioactivity. Fresh untreated maize stems were provided to them for further development. Each radioactive pupa was separated and kept in a tube until emergence of the adult. The activity of the adult moth was recorded on emergence. These moths were then separated into males and females and pairs kept separately for mating and egg-laying. The egg masses were assayed for radioactivity, and transferred to glass rearing jars for hatching. The eggs hatched within 4-6 d. On hatching, 1st-instar caterpillars were also assayed for radioactivity. The initial radioactivity ranged between 33 and 53 cpm. Radioactivity in the subsequent instars (2nd-4th) ranged from 6-29 cpm, whereas in the adults it ranged between 2828 and 22 759 cpm. When the adults were allowed to mate they laid fertile eggs with detectable radioactivity. Thus activity could be recorded not only in the adults but also in the subsequent generation up to 4th instar caterpillars. This observation may be useful in undertaking studies on the flight range and dispersal pattern, which would not be limited to the recovery of the liberated adults but also, in cases where the adults escape recovery, the range of flight will be evident from the location of the radioactive egg masses or the caterpillars which retain radioactivity up to the 4th-instar. (NSA 19: 1965, 27927)

3(2) Chigarev, G.A. THE PRESENT STATE OF THE PROTECTION OF POTATO AGAINST COLORADO BEETLE IN THE USSR AND THE PROBLEMS INVOLVED. Trudy vses. Inst. Zashch. Rast. 17 (1963) 324-43. (In Russian, with English summary)

Leptinotarsa decemlineata (Say) represents a serious menace to potato crops. Control is rendered difficult by the overwintering of adults in the soil at depths down to about 2 ft, the pupation of larvae in the soil at depths of about 1-8 in., and diapause in the soil sometimes lasting for more than a year. Moreover, the females lay an average of 300-500 eggs each, with an absolute max. of over 2500, there are two and sometimes three generations a year, the rate of population increase in high, and the beetles fly great distances (sometimes as much as 187 miles) and are resistant to adverse conditions. The present position in the Soviet Union is attributed to inadequacies in control. Where infestation is established, soil disinfestation is essential, but it has been used only for eradicating isolated foci. Imperfections are noted in the system of quarantine measures enforced, such as the procedure for detecting the numbers of adults emerging in spring. In the spring of 1960, ^{60}Co-labelled adults were released in the field, and the numbers counted on the following day. Only 67% of them were recovered in three repetitions, showing the ineffectiveness of visual inspection. (From RAE-A 54: 1966, 14)

4 Dafauce, C. RADIOACTIVE LABELLING OF INSECTS. Boln Serv. Plagas for. B 7, 14 (1964) 102-14. (In Spanish, with English summary)

5 (2) Dafauce, C., Cadahia, D., Astiaso, F. TRES EXPERIENCIAS CON Cryptorrhynchus lapathi L. (CURCULIONIDAE). MEDIANTE MARCADO RADIACTIVO. Boln Serv. Plagas for. 6, 11 (1963) 7-13. (In Spanish, with English summary)

In order to study the habits of the adults of C. lapathi L. on poplar in Spain, weevils were labelled in 1962 with ^{60}Co to which a coloured lacquer had been added to facilitate identification; the methods used are described. In the first experiment, 50 labelled pairs were introduced into an area measuring 3.28 X 3.28 yd in a young poplar plantation on 30th July. On 20th October, only three adults were found alive, 20 were dead and the rest had apparently been eaten by birds, radioactive droppings from which were present. The mean distance travelled per weevil was 21-63 yd, and only 10% had moved more than about 55 yd. In the second experiment, 25 marked pairs were put into a large nylon mesh cage covering 24 young poplars on 31st October, in order to protect them from predators, and were left over winter. Inspections on 26th and 28th January and 2nd May 1963 showed that the females survived better than the males and that more females died in the second part of the hibernation period than in the first; the total percentages of survival were 37.5 for females and 8.3 for males. Oviposition began before overwintering and was resumed after it. In a test on control, 50 marked adults were released into each of two poplar groves, which were then sprayed with 2% parathion, in June and October 1962, respectively; inspections in August and November showed that the spray was not effective and that again many of the weevils had been eaten by birds. (RAE-A 53: 1965, 316)

6 Davies, J.B. THREE TECHNIQUES FOR LABELING Culicoides (DIPTERA: HELEIDAE) WITH RADIOACTIVE TRACERS BOTH IN THE LABORATORY AND IN THE FIELD. Mosquito News 25, 4 (1965) 419-22.

Three techniques were developed for labelling larvae of Culicoides furens Poey and C. barbosi Wirth and Blanton, from the Jamaican swamps. They consisted of (1) direct application to larvae in the laboratory (by placing them directly in solutions containing from 0.5-5 μCi ^{32}P/ml, the larvae becoming labelled within 24 h); (2) direct application to mud in the laboratory (larvae in mud samples from the field were labelled by spreading out the mud into a 1"-layer and applying 200 ml of a solution containing 50 μCi ^{32}P (0.25 μCi/ml) to each square ft of mud surface, sandflies emerging over the following 9 weeks being radioactive); (3) direct application to mud in the field (^{32}P applied at 50 μCi/ft^2 to the mud of the larval habitat; about 50% of the emerging adults proved radioactive).

7 Gangwere, S.K., Chavin, W., Evans, F.C. METHODS OF MARKING INSECTS, WITH ESPECIAL REFERENCE TO ORTHOPTERA (SENS. LAT.) Ann. ent. Soc. Am. 57, 6 (1964) 662-9.

Radioactive and non-radioactive methods used in the past for marking insects, and their applicability to orthopterous insects (sens. lat.), are evaluated on the basis of experimentation, prior field and laboratory experience, and critical analysis of pertinent literature. Radioactive methods based on external application of the isotope are found unsatisfactory for use on Orthoptera; but internal application by ingestion, by surgical insertion, and especially by injection, are suitable for this group of insects, though the ingestion method is subject to several limitations. The non-radioactive methods, grouped into 13 broad categories, are virtually all unsatisfactory for Orthoptera. Fluorescent materials (for nocturnal species) and various kinds of paints indicate some promise, but their applications are limited. One method, the amputation of tegmina, is useful, especially in combination with the new "notch technique". This latter consists of the removal, with fine iris scissors, of V-shaped portions of exoskeleton from the fore, hind, and lateral margins of the pronotum. Various assortments of these notches, in combination with half or full amputation of tegmina, yield a large number of distinctive marks which are readily applied and interpreted in the field, easily supplemented with paint, and reasonably persistent through at least the later life stages; yet they do no apparent harm to the tagged insects. (Auth.)

8 McAllan, J.W., Neilson, W.T.A. LABELING THE APPLE MAGGOT WITH STRONTIUM 89. J. econ. Ent. 58, 1 (1965) 168.

When newly emerged adults of Rhagoletis pomonella (Walsh) were allowed access to pads of absorbent cotton soaked in 50% apple juice containing ^{89}Sr at 2 μCi/ml, all the flies became labelled with the isotope within 6 d and retained measurable amounts for at least 46 d. There was wide variation in the amounts ingested by different flies, and there was no significant difference between the sexes; there also appeared to be no relation between mortality and the dosage rate. (RAE-A 53: 1965, 245)

9 Peleg, B.A., Gothilf, S. LABELING OF EGGS OF THE CAROB MOTH, Ecromyelois ceratoniae (Zeller), WITH P^{32} FOR ECOLOGICAL STUDIES. Israel J. agric. Res. (Ktavim) 14, 2 (1964) 75-76.

Radioactive eggs of the carob moth were obtained by introducing ^{32}P into the diets of the larvae. Females which had, in the larval stage, been fed 10 μCi of ^{32}P/g of dry food laid eggs yielding an average count of 56 cpm, which is sufficient to enable subsequent adult migration to be tracked (females start ovipositing shortly after emergence, and incubation of the eggs is completed within 3-10 d).

10 Peleg, B.A., Nadel, D.J. A NEW METHOD OF P-32 LABELLING OF THE SCALE PREDATOR, Chilocorus bipustulatus L. (COCCINELLIDAE), WITH POSSIBLE APPLICATION TO OTHER SCALE PREDATORS. WP/31/7, International Atomic Energy Agency, Vienna (Austria), 1965, p.3. Unpublished. Preliminary communication.

11 Rahalkar, G.W., Doutt, R.L. A COMPARISON OF PROCEDURES FOR MARKING ADULT ENDOPARASITIC WASPS WITH P^{32}. J. econ. Ent. 58, 2 (1965) 278-81.

Two methods of labelling adults of Phanerotoma flavitestacea Fischer (Hymenoptera: Braconidae) with ^{32}P have been compared. Freshly emerged adult parasites fed on honey mixed with ^{32}P acquired radioactivity that was detectable up to 36 d. Longevity was not seriously affected. Although ingested radiophosphorus was lost mostly through excretion, some was lost through oviposition. Host eggs parasitized by marked female parasites showed detectable levels of radioactivity. Marking adults by rearing them in hosts feeding on radioactive food is not a satisfactory technique with Phanerotoma. The higher concentrations of ^{32}P in the host food adversely affected emergence of the adult parasites, while at the lower concentrations the emerging adults showed only very low levels of radioactivity. (Auth.)

See also:

12 Effects of the ingestion of radioactive phosphorus by the fruit fly (Ceratitis capitata Wied.) on the eggs laid. (Arroyo Varela, M., Mellado Brauns, L., 1964)
40 Retention of radioactive phosphorus in the body of the human louse (Pediculus humanus L., Anoplura). (Piotrowski, F., Rudnicki, T., 1965)
262 Labelling of certain areas of pigmentation on butterfly wings with ^{35}S-sodium sulphate and ^{35}S-DL-cystine solutions. (Luedicke, M., Peterhänsel, H., 1965)
276 Observations on the feeding habits of the mosquito Aëdes (Stegomyia) aegypti (Linnaeus): The loss of fluid after a blood-meal and the amount of blood taken during feeding. (Boormal, J.P.T., 1960)
282 Relation of distance to foraging intensity of honey bees (Apis mellifera) on natural food sources. (Lee, W.R., 1965)
286 ^{32}P-labeled semen for mosquito mating studies. (Dame, D.A., Schmidt, C.H., 1964)
291 Etude du comportement alimentaire et des relations trophallactiques des mâles au sein de la société de guêpes au moyen d'un radio-isotope. (Montagner, H., 1964)
292 The dispersal flight of Meligethes beetles and spring migration of delphacids with special reference to the application of the tracer method. (Dlabola, J., Taimr, L., 1965)
293 Tagging the oriental fruit moth, Grapholitha molesta (Busck) with radioactive phosphorus for flight and dispersal studies. (Dustan, G.G., 1965)
297 The use of radioactive tracers in the study of dispersion of Orthotylus virescens (Douglas and Scott) (Miridae, Heteroptera). (Lewis, C.T., Waloff, N., 1964)
303 Dispersal studies of Trichogramma semifumatum (Hymenoptera: Trichogrammatidae) tagged with radioactive phosphorus. (Stern, V.M. et al., 1965)
314 Predators of Aedes atropalpus (Coq.) (Diptera: Culicidae) and of other mosquitoes breeding in rock pools in Ontario. (James, H.G., 1965)

319 Les radioisitopes en écologie animale: I. Expériences sur le marquage de pucerons vecteurs de la jaunisse de la betterave. (Impens, R. et al., 1965)

2. Developmental, Physiological, and Genetic Effects of Isotopic Labels

12 Arroyo Varela, M., Mellado Brauns, L. EFECTOS DE LA INGESTION DE FOSFORO RADIACTIVO EN LA PUESTA DE LA MOSCA DE LAS FRUTAS (Ceratitis capitata Wied.). Boln Patol. veg. Ent. agric. 27 (1964) 183-200.

The possibility of introducing and releasing Opius concolor Szépl. against Dacus oleae (Gmel.) on olive in Spain is being considered, and large numbers of the parasite are being reared in the laboratory on C. capitata (Wied.). Since radioactive labelling, particularly of the eggs, would greatly facilitate evaluation of the parasite's effectiveness when released, various techniques of labelling C. capitata were studied, and details are given of them and of the results obtained. When ^{32}P was incorporated into food supplied to the adults, 1% of the total amount of radioactivity supplied was detected in the eggs laid and the degree of radioactivity varied hardly at all between eggs. When larvae were given food containing ^{32}P, about 40% of the radioactivity supplied was detected in the resulting pupae (excluding those formed on the first day of pupation). It is thought that these percentages could be increased by improvements in the techniques employed. (RAE-A 53: 1965, 594)

13 Bennett, G.F. THE EFFECT OF PHOSPHORUS^{32} ON THE FECUNDITY OF Aedes aegypti (L.) AND ITS USE IN DETERMINING BLOOD MEAL VOLUMES. Mosquito News 25, 4 (1965) 465-9.

The volume of blood ingested by A. aegypti was determined by a gravimetric method and found to be 1.63 mm^3/mosquito. The volume of blood ingested, determined by a method involving ^{32}P was 3.0 mm^3. The isotope was administered to young ducklings in the form of $H_3{}^{32}PO_4$, 3-10 d prior to allowing mosquitoes to feed. (See II/276 and 483). The fecundity of mosquitoes fed on ^{32}P-labelled blood proved lower than that of mosquitoes fed on non-labelled blood. The lowered fecundity persisted when radioactive mosquitoes were fed on non-labelled blood. The viability of radioactive eggs (at the level of radiation used) was not affected by the presence of the isotope.

14 Kaplan, W.D., Gugler, H.D., Kidd, K.K., Tinderholt, V.E. NONRANDOM DISTRIBUTION OF LETHALS INDUCED BY TRITIATED THYMIDINE IN Drosophila melanogaster. Genetics 49, 4 (1964) 701-14.

Mutations have been induced in Drosophila males by ^{3}H-thymidine fed to larvae or injected into adults. Radioautographs of testes of treated males demonstrated a correlation between the occurrence of mutations and the presence of labelled sperm bundles. In addition to the presence of sex-linked recessive lethals, dominant lethals were also measurable. Mapping of the induced sex-linked recessive lethals disclosed a non-random distribution which differed from reported distributions of mutations induced by x-rays and γ-rays. Distribution of mutations induced by ^{3}H-thymidine appears to reflect the varying frequency with which thymidine bases occur along the length of the Drosophila X-chromosome. (Auth. summary)

15 Kaplan, W.D., Gugler, H.D., Kidd, K.K. THE DISTRIBUTION OF SEX-LINKED RECESSIVE LETHALS INDUCED IN Drosophila MALES BY TRITIATED DEOXYCYTIDINE. Genetics 52, 2, Pt. 2 (1965) 451. Abstr.

In previously reported work the distribution of sex-linked lethals induced by ^{3}H-thymidine was shown to be non-random along the length of the X-chromosome. Furthermore, the distribution differed from those obtained by others following x- or γ-irradiation. The deoxycytidine distribution differs from the thymidine distribution in two regions of the chromosome, the other regions being similar. These results are in accord with the hypothesis that the relative frequencies of thymine and cytosine bases vary significantly along the length of the chromosomes. (Abstr.)

16 Kent, E. THE EFFECT OF TRITIATED THYMIDINE AND GAMMA IRRADIATION ON THE MORTALITY OF ADULT Drosophila melanogaster. ÇNAEM 32, Turkey. Atomic Energy Commission. Çekmece Nuclear Research Center, Istanbul. Nov. 1965, 11p.

Several factors which might affect the mortality rate in adult D. melanogaster exposed to ionizing radiations as larvae were studied. 72-h-old larvae were irradiated (whole-body γ-irradiation for 2 h) and/or irradiated nutrient containing ^{3}H-thymidine given; in some cases the same larvae received repeated treatment. Hot nutrient consisted of a homogenized mixture of 3 g of banana, 20 mg of sugar, 20 mg of dried yeast, and of ^{3}H-thymidine. The exposure of the same larvae to ^{3}H-thymidine and γ-irradiation at different times caused a high additive mortality rate. Simultaneous application of the two treatments (β-irradiation from ^{3}H-thymidine, and γ-irradiation) produced a greater than additive rise in mortality rate. Irradiated hot nutrient proved harmful to larvae, and seemed responsible for the increased mortality rate when both factors were involved simultaneously.

17 Kent, E. THE EFFECT OF TRITIATED THYMIDINE AND GAMMA IRRADIATION ON THE MORTALITY OF Drosophila melanogaster LARVAE. ÇNAEM 16, Turkey. Atomic Energy Commission. Çekmece Nuclear Research Center, Istanbul. 1964, 7p.

(Orally administered) ^{3}H-thymidine and total body radiation (from a 1.02 Ci ^{60}Co-source) increased the mortality rate of 72-h-old larvae when applied simultaneously at certain ratios. A comparable rise was not observed when only one was administered. The combined effect of the two factors was higher than additive, and ^{60}Co-irradiation was the more effective one. The phenomena are discussed.

18 Kent, E. THE EFFECT OF TRITIATED THYMIDINE AND GAMMA IRRADIATION ON THE MORTALITY OF Drosophila melanogaster LARVAE. A/CONF. 28/P/856, 3rd UN International Conference on the Peaceful Uses of Atomic Energy. May 1964, 7p.

See ref. 16

19 Kharlamov, V.P. SOME PHYSIOCHEMICAL INDEXES OF GASEOUS EXCHANGE IN THE HOUSEFLY Musca domestica AND OF DNA NUCLEOTIDE COMPOSITION OF FIRST-GENERATION LARVAE, FOLLOWING INTERNAL β-IRRADIATION BY PHOSPHORUS-32. Radiobiologiya 4, 6 (1964) 893-5. (In Russian).

Following feeding ^{32}P for two consecutive days at a rate of 2 and 0.02 μCi/ml feed (milk), the average radioactivity of house flies was 5200-7500 and 50-60 cpm, respectively. The retention time of ^{32}P was 40 d at the higher dose, and 25 d at the lower dose. Five days after the introduction of ^{32}P, the total dose absorbed was 8030 and about 80 rad, at the higher and lower dose, respectively. At this irradiation stage, flies receiving the higher dose of ^{32}P showed a reduction of O consumption, and a reduction of the R.Q. by 27%. The smaller dose had the opposite effect (the increase of R.Q. was 8%). Histological study showed that the isotope was distributed mainly in the intercellular spaces of the abdominal cavity with higher amounts accumulating in the gonads. Irradiation, even at the higher dose, caused no changes in the nucleotide composition of the DNA of the progeny (larval stage). (CA 62: 1965, 5618c)

20 Kharlamov, V.P. A CHANGE IN THE ACTIVITY OF FEEDING AND MOBILITY OF THE FLEAS Xenopsylla cheopis MARKED WITH RADIOACTIVE PHOSPHORUS ^{32}P. Zool. Zh. 44, 4 (1965) 547-51.

A change in the feeding activity and mobility of X. cheopis resulting from internal β-irradiation caused by labelling with different concentrations of ^{32}P was studied. When animals were labelled with ^{32}P, giving an initial activity of 0.5 μCi/g, feeding activity increased by 22% and mobility by 31% compared with controls. When an initial activity of 60 μCi/g was used, the contrary was observed, i.e. feeding activity decreased by 46% and mobility by 32%. Under the given experimental conditions, a direct correlation was found between feeding activity and mobility, with a highly significant correlation factor of 0.956.

21 Kuzin, A.M., Glembotskiĭ, Ya. L., Lapkin, Yu. A., Kalendo, G.S., Bregadze, Yu.I., Mamul, Ya. V., Myasnyankina, E.N. ON THE MUTAGENIC EFFECTIVENESS OF INCORPORATED ^{60}C. Radiobiologiya 4 (1964) 804-9. (In Russian)

Incorporated ^{14}C had a dose-dependent mutagenic effect on Drosophila melanogaster from 444-610 sex-linked recessive lethal mutations for 1 rad/10 gametes. A 2.7-fold increase in the dose increased the percentage of mutations 3.5-fold. Gamma irradiation of the eggs, larvae, and pupae caused from 192-264 lethals, averaging 207, per rad/10^{7} gametes. In adult males the figure was

162 per rad/10^7 gametes. The ^{14}C effect was 2.5 times that of chronic external γ-irradiation from ^{60}Co. Chronic γ-irradiation at all stages of development was 20% more effective than that of adult males. (Tr-auth.)

22 Lee, W.R., Oden, C.K., Bart, C.A., Debney, C.W. MUTAGENIC EFFECT ON MATURE *Drosophila* SPERMATOZOA OF P^{32} INCORPORATED INTO DNA. *Genetics* *52*, 2 Pt. 2 (1965) 455. Abstr.

Transmutation of ^{32}P to ^{32}S and the accompanying energy released by steric changes in the molecule and recoil of the ^{32}S nucleus have been separated from the mutagenic effect of the accompanying β-radiation. Spermatozoa were labelled by feeding ^{32}P to young, 3rd instar larvae which, upon eclosion, were divided into two groups and mated to: (1) females from whom brood was immediately produced; (2) females who after mating were stored for 3 weeks at 18°C before being allowed to produce a brood. Mutation rate in progeny of the second group less that of the first group was taken as the mutation rate induced into mature spermatozoa by ^{32}P decay. Incorporation of ^{32}P was determined by counting spermatozoa microscopically, washing with cold trichloroacetic acid, and determining the radioactivity with a liquid scintillation detector. Assuming that 2/15 of the ^{32}P incorporated into DNA is in X-chromosome euchromatin, there were from 10-60 disintegrations in the X-euchromatin during storage. Because of the high energy of the ^{32}P β-particle, only a negligible dose is received by sperm from β-radiation during storage. No differences were found in the relative rate of chromosome breakage in the two groups, as the frequency of loss of marked B^S. Y in F_1 males was 1.3% ±.2% (N=12 781) and 1.2% ±.2% (N=9 531) for the first and second group, respectively. The frequency of sex-linked recessive lethals was 1.7% ± .3% (N= 8 888) and 1.6% ± .3% (N=7 593) in the first and second group, respectively. Therefore, less than one ^{32}P disintegration in 2000 will produce a "complete" recessive lethal. (Abstr.)

23 Olivieri, G., Olivieri, A. THE MUTAGENIC EFFECT OF TRITIATED URIDINE IN *Drosophila* SPERMATOCYTES. *Mutation Res.* *2*, 4 (1965) 381-4.

Experiments were carried out to determine whether β-irradiation emitted by ^{3}H-uridine incorporated into RNA would be mutagenically effective. Since actinomycin D may be expected to inhibit its incorporation but not that of ^{3}H-thymidine, a comparison of the mutagnic effectiveness of the two tritiated nucleotides was made, with and without actinomycin D co-treatment. Under the prevailing experimental conditions ^{3}H-uridine proved more mutagenic than ^{3}H-thymidine despite the greater specific activity of ^{3}H-thymidine and the only transient presence in the nucleus of ^{3}H-uridine. Actinomycin D greatly inhibited the labelling of the cytoplasm (noticeable some hours after the administration of uridine). It does not, however, inhibit the nucleolar labelling during the first 30 min after isotope administration. Actinomycin D increases the frequency of x-ray induced mutations when irradiation is carried out within 1 h after actinomycin D administration which is in agreement with the fact that actenomycin D enhances the frequency of ^{3}H-uridine induced mutations.

24 Purdom, C.E. GENETIC EFFECT OF INCORPORATED ^{14}C IN *Drosophila melanogaster*. *Mutation Res.* *2*, 2 (1965) 156-67.

A method was described for the quantitative incorporation of ^{14}C into *Drosophila*. Recessive lethal mutation frequencies were measured in successive 2-d-broods for male and female flies grown on media containing ^{14}C-labelled glucose of specific activities of 0.1 and 0.05 mCi/g. Although there was some evidence that incorporated ^{14}C might be excessively toxic to the developing organism, preliminary genetic results suggested that the mutagenic effect of incorporated ^{14}C was due largely to the emitted β-radiation. The possibility remained that a small transmutational genetic effect was not detectable on statistical grounds. The upper limit to such an effect in females was less than 0.01 but in males this level of effect could not be ruled out. No evidence was found for the production of mosaic mutations by the $^{14}C \rightarrow {}^{14}N$ transmutation. (Auth.)

25 Riordan, D.F. EMERGENCE AND FERTILITY OF *Aedes aegypti* (L.) REARED IN VARIOUS CONCENTRATIONS OF P^{32}. *Can. J. Zool.* *43* (1965) 497-501.

A. aegypti (L.) was reared in eight concentrations of ^{32}P from 0.05-0.8 μCi/ml to test the effects on fertility of the adults. Up to 0.3 μCi/ml little effect was seen in the numbers pupating, but at 0.2 μCi/ml and higher many of the adults were so weakened as to be unable to leave the surface of the water. At 0.6 and 0.8 μCi/ml no adults lived to become parents of a succeeding generation. No progeny were produced by females reared at 0.2 μCi of ^{32}P/ml or by non-radioactive females mated to males reared at 0.3 μCi of ^{32}P/ml. Amounts of ^{32}P in the adults of males and females were calculated. (Auth.)

26 Rudkin, G.T. THE RELATIVE MUTABILITIES OF DNA IN REGIONS OF THE X-CHROMOSOME OF *Drosophila melanogaster*. *Genetics* *52*, 3 (1965) 665-81.

The relative DNA contents of ten regions of the X-chromosome in four salivary gland nuclei of fully grown larvae and prepupae were determined by cytophotometric measurements of ultraviolet absorbance (λ = 257 nm) of chromosomes treated with ribonuclease. The regions were bounded by the cytogenetic loci of the 11 marker genes, *y*, *z*, *w*, *spl*, *ec*, *ct*, *v*, *g*, *f*, *car* and *bb*. The "apparent relative mutability" of a chromosome region is defined as the ratio of the percentage of all mutations that were found to occur in the region to the percentage of DNA in the region. Apparent relative mutabilities were determined for 7-10 regions on the basis of eight published sets of sex-linked lethal and visible mutations: five sets produced by x-ray treatment, one set by a "mutator gene", one set by incorporated ^{3}H-thymidine and one set by incorporated ^{32}P. The apparent relative x-ray sensitivities of the regions were not demonstrably different from one another. Lethal mutations induced by Ives' mutator gene *hi* were not randomly distributed among four chromosome regions; visibles were. Differences between the susceptibilities of the regions to the different mutagenic treatments are suggested but not established by the data. The theory of chromosome evolution by duplication would predict redundance of genetic function in duplicate regions after the duplication event and until the two regions had diverged by mutation to have different functions. No evidence for different degrees of redundance was found, for the distribution of the observed mutations was not related to the number of bands, the ratio of single to double bands, or to the average DNA contents of the bands in the regions analysed. (Auth. summary)

27 (1) Suomalainen, E., Turpeinen, O., Niini, R. MUTATIONS IN *Drosophila melanogaster* GROWN ON MEDIA CONTAINING CARBON-14 LABELLED SUGARS. *Nature*, Lond. *178* (1956) 357-8.

The mutagenic action of ^{14}C was investigated by rearing *D. melanogaster* from eggs to adults on ^{14}C-containing media (a modification of Spencer's medium was used to which labelled sugars from *Canna indica* were added at concentrations of 0.1 mCi or 1 mCi per culture bottle). In the course of of their 15 d development the flies received 800 R; no one stage was involved exclusively. The frequency of X-chromosome lethals (2.2-2.8%) was approximately the same as that reported by other workers after a dose of 100 R. The increase in mutation rate may, on the whole, be accounted for by released β- radiation.

See also:

35 Localization, persistence and resultant genetic effects in invertebrates of ingested fourth period metals in stable and radioactive forms. (Grosch, D.S., 1964)
134 Some factors influencing the utilization of tritiated thymidine in grasshopper embryos. (Leach, W.M., 1965)
681 Comparative studies of mutation frequencies induced by ^{32}P treatment and γ-irradiation in the male silkworm. (Ikenaga, M., Kondo, S., 1965)
699 Comparative studies of mutation frequencies induced by ^{32}P treatment and γ-irradiation in the male silkworm. (Mituo, I., Kondo, S., 1965)
780 Fifth report from Norsk Hydro' Institute for Cancer Research for 1963-1964. (Norsk Hydro's Institute for Cancer Research, Olso, 1965)

B. INSECT PHYSIOLOGY AND BIOCHEMISTRY

1. General Articles. Surveys

28 SEMINAR ON INSECT BIOCHEMISTRY. "Seminar on Insect Biochemistry, Chiba, Japan, 20 Jun. -3 Jul. 1965".

see Levenbook, ref. 136.

29 Barton-Browne, L.B. WATER REGULATION IN INSECTS. A. Rev. Ent. 9 (1964) 63-78.

Review article, divided into sections dealing with tolerance to osmotic and ionic changes in body fluids, cuticular transpiration, water loss from spiracles, the control of excretion, of water ingestion, regulation involving endogenous materials, the role of behavioural mechanisms in water regulation, and water relations of insects in nature. Radioisotopes had been used in a number of studies cited but are nowhere mentioned specifically in the text.

30 Winteringham, F.P.W. SOME DISTINCTIVE FEATURES OF INSECT METABOLISM. p. 29-37 of "Aspects of Insect Biochemistry. Biochemical Society Symposium No. 25, London, 1 Apr. 1965". Goodwin, T.W., Ed. London, Academic Press. 1965, 107p.

A survey article, stressing differences in metabolism at the molecular level between insects and other animal classes, of importance for the development of safer and more selective chemicals in insect pest control. The roles of certain compounds in metabolism are discussed, such as vitamin K, nicotinic acid, sterols, amino acids, trehalose, glycerol, ecdysone and other enzymes, juvenile hormone, etc. Numerous studies are cited in which radioisotopes had been used.

31(2) Wyatt, G.R. METABOLIC REGULATION IN THE DEVELOPMENT OF INSECTS. p. 179-88 of "Control Mechanisms in Respiration and Fermentation". Wright, B., Ed. Cardiff, The Ronald Press Company. 1963.

Review article. Respiration during insect metabolism, and the control of respiration in the diapausing pupa are discussed, drawing freely on evidence obtained in studies in which radioisotopes had been used. The production of glycerol and its regulation are considered. The considerable range in biosynthetic rates between diapause and development is illustrated in work on the incorporation of ^{14}C-leucine into Cecropia fat body proteins.

See also:

43 Some comparative aspects of the metabolism of carbohydrates in insects. (Chefurka, W., 1965)

2. Elements. Ions. Inorganic Salts

32 Crossley, D.A., Jr. RADIOCESIUM ACCUMULATION AND FEEDING BY WILLOW LEAF BEETLES (Chrysomela knabi Brown). p. 73-4 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct. 1964.

Experiments were carried out to test the validity of predicting ^{137}Cs accumulation in the field from laboratory data. Larvae conveniently feed only on willow leaves, remain on the host plant, and are easily collected. ^{137}Cs concentrations in willow leaves and in various stages of C. knabi are tabulated for 1962-4, in collections made from May-June from White Oak Lake bed. Samples in 1963 and 1964 had to be taken by boat due to reflooding of the bed. ^{137}Cs-concentration in samples of other stages of the beetle appeared to be consistent with results in the laboratory. Reduction in ^{137}Cs concentration in pupae was apparently due to clearance of stored metabolites from the larvae immediately prior to pupation. Adult stages were more active than larvae, with more rapid elimination rates and lower ^{137}Cs equilibrium concentrations.

33 Crossley, D.A., Jr. BIOLOGICAL HALF-LIFE FOR RADIOCESIUM IN APHIDS. p. 74 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct. 1964.

Experiments were aimed at checking whether available information on biological half-lives could be applied to insect species with sucking rather than chewing mouthparts. Bases of nasturtium (Tropaeolum majus) twigs infested with bean aphid, Aphis fabae, were inserted in aqueous solutions of ^{134}CsCl. After 3 d ~30 aphids were transferred to unlabelled twigs. Estimates of biological half-lives at 8, 18, and 28°C were 42, 23, and 11 h, respectively. A doubling of the elimination rate for each 10°C increase was indicated. Small beetle larvae (Chrysomela knabi, weight ~2 mg) had biological half-lives > 6 h at 24°C for Cs. Biological half-lives were longer than expected for insects of that size (live weight ~0.51 mg). Size-elimination rate relations are being studied further (on Oncopeltus fasciatus).

34 Getsova, A.B., Volkova, G.A. ACCUMULATION OF RADIOACTIVE ISOTOPES OF PHOSPHORUS, YTTRIUM, IODINE AND MERCURY BY LARVAE OF AQUATIC INSECTS. Zool. Zh. 43 (1964) 1077-80. (In Russian) Translation available in Fedn Proc. 24, Transl. Suppl., part II (July-Aug. 1965) T683-4.

Larvae of seven representative aquatic insects were placed in separate aquaria containing pond water and 10 μCi/1 of ^{131}I, ^{203}Hg, ^{32}P, or ^{91}Y was added to each aquarium. Experiments were conducted on Glyphotaelius punctatolineatus Retz., Halesus interpunctatus Zett., Eristalis tenax L., Cloën dipterum L., Aeschna grandis L., Lestes sponsa Hans, and Leucorrhinia rubicunda L., There was maximum accumulation of Y by most of the species investigated, the next highest being Hg. There was high accumulation of P by only two species: E. tenax and G. punctatolineatus; all species showed least accumulation of I. Highest accumulation of all four elements was consistently demonstrated by G. dipterum, followed by G. punctatolineatus, while A. grandis demonstrated lowest accumulation. (See NSA 19: 1965, 8774 and 42247)

35 Grosch, D.S. LOCALIZATION, PERSISTANCE AND RESULTANT GENETIC EFFECTS IN INVERTEBRATES OF INGESTED FOURTH PERIOD METALS IN STABLE AND RADIOACTIVE FORMS. Final Report. TID-21559, North Carolina State Coll., Raleigh. Oct. 1964, 22p.

The effects of the ingestion of a single meal of sucrose solution containing sulphates of Mn, Fe, Co, Ni, Cu, or Zn on the fecundity, fertility, life span, and phenotype of the wasps, Habrobracon juglandis and H. seriopae, were measured. Co and Ni were the most toxic from the standpoint of altered fecundity and fertility. Cu and Zn had only moderate effect at sublethal doses, and Mn and Fe had little effect. Exposure of females fed Mn, Ca, Ni, Cu, or Zn to single or fractionated non-sterilizing doses of x-radiation showed a synergistic effect for x-radiation and feeding of these cations. Feeding ^{58}Co, ^{63}Ni, or ^{65}Zn at concentrations of 100 μCi/ml gave results characteristic of metal poisoning rather than radiation damage. Results are included from measurements of radioisotope distribution using standard counting and autoradiographic techniques, determinations of the relative radioactivity of eggs, and studies on the effects of tissue transplants on egg production. (NSA 19: 1965, 10741)

36 Kormondy, E.J. UPTAKE AND LOSS OF ^{65}Zn IN THE DRAGON-FLY Plathemis lydia. Limnol. Oceanogr. 10 (1965) 371-78.

Study of uptake and loss of ^{65}Zn in the dragonfly P. lydia employed concentrations of 0.005 - 0.5 μCi ^{65}ZnCl$_2$/ml water on 200 early, middle, and late instar larvae. Rate and amount of uptake are independent of temperature (10, 20, and 30°C): equilibrium is attained in 24 - 48 h. Loss rate is significantly greater at 10°C than at 20 and 30°C. Uptake and loss rates are independent of body size (= age), but the amount concentrated is inversely related to body size, the coefficient of accumulation being 68 in small larvae, 28 in larger ones. Total uptake is directly proportional to isotope availability in the medium; owing to experimental error, it could not be determined whether rate of uptake is affected by concentration. Loss rates in the field and the laboratory do not differ. Feeding experiments are inconclusive. Loss rate in dead animals is the same as in live larvae, and 95% of initial activity remains on the cast exuvium at moulting and final metamorphosis. Uptake is concluded to be by surface adsorption or cation exchange thereby imposing difficulty in using ^{65}Zn as an indicator of metabolic activity in energy flow studies. Odonata may function significantly in redistributing Zn, the bulk of which localizes in the upper sediments. (Auth.)

37 Martoja, R. DONNEES BIOCHIMIQUES ET HISTOCHIMIQUES SUR L'INCORPORATION DU SULFATE DE SODIUM RADIOACTIF, CHEZ Gryllus bimaculatus de Geer (INSECTE, ORTHOPTERE). C.R. hebd. Séanc. Acad. Sci., Paris 258, 13 (1964) 3550-3.

Après injection ou ingestion de sulfate de sodium radioactif (10 à 20 μCi), une forte radioactivité est mise en évidence, par chromatographie, dans les acides aminés soufrés du Grillon. Par l'analyse histochimique et histoautoradiographique, on peut situer l'origine de l'émission radioactive à la fois sur les protéines sulfhydrilées de nombreux organes, et, pour une moindre part, sur les sulfomucopolysaccharides du tissu conjonctif. (Auth.)

38 Mitlin, N., Bartlett, A.C., Keller, J.C. ELIMINATION RATE AND EFFECT ON REPRODUCTION OF INGESTED RADIOPHOSPHORUS IN THE BOLL WEEVIL. J. econ. Ent. 58, 1 (1965) 119-21.

The biological half-life of ingested ^{32}P in the boll weevil, Anthonomus grandis Boheman, was 5.3 d in females and 7.3 d in males. Germ cells were relatively resistant to effects of the isotope. Ingested amounts up to 3.5 μCi caused only a small decrease in fecundity, and when either the male or female was fed no effects on progeny or genetic changes could be detected. Sterile matings resulted only when both sexes were fed the isotope. There was no obvious chromosomal damage in the germ cells and no phenodeviants appeared in insects reared to the third filial generation. By feeding ^{32}P, sperm or seminal fluid or both could be labelled and traced to the spermatheca and ovaries of mated females. Larvae reared in a radioactive medium were inhibited in their development and only a small percentage developed to adulthood. (Auth.)

39 (2) Odum, E.P., Marples, T.G. BIOELIMINATION OF Zn^{65} AND Fe^{59} IN RELATION TO KIND OF FOOD EATEN. Bull. ecol. Soc. Am. 44, 3 (1963) 74-5. Abstr.

In a continuing effort to explore the possibilities of using radionuclide tracers as indices of activity and feeding rates in nature, a series of experiments are in progress in the laboratory in which bioelimination of ingested tracers is measured in individuals maintained on different kinds of food. So far no effect of kind of food has been demonstrated in larval chewing insects or adult sucking insects. However, high concentrations of malic acid added to drinking water of the latter resulted in increased bioelimination suggesting that plant juices, which may contain such chelators, could be a factor affecting the elimination rate in nature. (Abstr.)

40 Piotrowski, F., Rudnicki, T. RETENTION OF RADIOACTIVE PHOSPHORUS IN THE BODY OF THE HUMAN LOUSE (Pediculus humanus L., ANOPLURA). Acta physiol. pol. 16 (1965) 435-39. (In Polish)

Retention of radioactive phosphorus in the body louse was investigated. It was found that the mean effective half time of ^{32}P was 2.2 d. Excretion of ^{32}P takes place in the phases: in first with the turnover rate $k_1 = 0.2$, and in the second with $k_2 = 0.02$. The method employed permits labelling of body lice for a period of 1-2 weeks. (Auth.)

41 Reichle, D.E., Dodson, G.J. BIOLOGICAL HALF-LIVES OF ^{134}Cs IN FOREST-FLOOR ARTHROPODS. p.70-71 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p.

The retention of ^{134}Cs by two cryptozoan species (Spaeroderus stenostomus, Coleoptera, and the wood roach, Parcoblatta) are shown graphically. The biological half-lives, T_b, are tabulated for 12 cryptozoan species. Coleoptera (Carabidae, Passalidae) were all characterized by single-component systems, regardless of feeding mechanisms or trophic position. In the Orthoptera, crickets (Gryllidae) also exhibited single-component retention curves, although the retention curve for the wood roach (Blattidae) consisted of two components. T_b averaged about 1 d. Further factors affecting elimination rates were body size and temperature.

42 Stobbart, R.H. THE EFFECT OF SOME ANIONS AND CATIONS UPON THE FLUXES AND NET UPTAKE OF SODIUM IN THE LARVA OF Aedes aegypti (L.) J. exp. Biol. 42 (1965) 29-43.

Starved 4th-instar larvae of A. aegypti, when put into deionized water at a density of ten larvae/30 ml, are able to achieve sodium balance at the low external concentration of 5 μM Na/l. The balancing process involves a 10% drop in total sodium content, a more or less complete activation of the mechanism for sodium transport, and a reduction in the permeability of the larva to sodium as measured by the net sodium loss into deionized water. It is very probable that most of this reduction occurs in the anal papillae. The relationship between external sodium concentration and sodium influx in larvae previously 'balanced' in deionized water is described approximately by the Michaelis equation. The sodium outflux also increases with increasing external sodium concentrations. ^{22}Na was used. The net uptake of sodium by 'balanced larvae' appears to be significantly greater from solutions of NaCl than from solutions of $NaNO_3$, $NaHCO_3$, and Na_2SO_4. The ions K^+ Ca^{++} Mg^{++} and NH_4^+ when present as chlorides stimulate the influx of sodium from 0.1 mM/l. sodium chloride. When present as nitrates or sulphates they either have no effect or cause an inhibition of influx. The results in 4 and 5 suggest that movements of chloride may be important in sodium uptake, and chloride uptake has been found to occur independently of sodium uptake. Measurements of potential difference between haemolymph and medium demonstrate active transport of both sodium and chloride. (Essentially auth. summary)

See also:

306 Biological vectors and reservoirs of strontium-90. (Nelson, D.J., 1964)

3. Carbohydrates

43 Chefurka, W. SOME COMPARATIVE ASPECTS OF THE METABOLISM OF CARBOHYDRATES IN INSECTS. A. Rev. Ent. 10 (1965) 345-82.

A comparative and critical discussion is presented. Whenever possible, results for insects are related to corresponding data for other members of the animal kingdom. Carbohydrates are discussed in terms of their degradation, synthesis and function (glycogen, trehalose and other carbohydrates being considered), and their metabolism (glycolysis, and the pentose phosphate and citric acid cycles). The discussion of terminal respiratory pathways is divided into sections on the constituents of the respiratory chain, mitochondrial stability and respiration, respiration control, and oxidative phosphorylation. The extensive bibliography (225 references) contains many references to radioisotope studies.

43-a (2) Brown, W.H., Felauer, F.E., Smith, M.V. BIOSYNTHESIS OF ROYAL JELLY FATTY ACID FROM SUCROSE. Nature, Lond. 195 (1962) 75-6.

Sucrose uniformly labelled with ^{14}C was fed to 1.5 lb worker bees deprived of their queen; they were confined on two frames of honey and pollen and forced to rear queen cells. 5 h after confinement 13 grafted queen cells were given to the confined bees. Royal jelly was collected at the end of 1, 2 or 3 d and the cells immediately regrafted and returned to the bees. Two collections of jelly at 3 d intervals gave optimum yield. A total of 8.8 g (fresh weight) of labelled royal jelly was produced. Its identity with an authentic sample of inactive royal jelly was confirmed by infra-red absorption spectra.

44 Egorova, T.A. TREHALOSE IN INSECTS. Uchen. Zap. mosk. gos. Univ. ped. Inst. 212 (1965) 14-24. (In Russian)

A review with 43 references.

45 Bricteux-Grégoire, S., Jeuniaux, Ch., Florkin, M. THE BIOCHEMISTRY OF THE SILKWORM. XXVIII. BIOSYNTHESIS OF TREHALOSE FROM PYRUVATE. Archs int. Physiol. Biochim. 72, 3 (1964) 482-8. (In French)

When pyruvate-^{14}C was injected into silkworms at the end of the 5th-instar, no radioactivity was found in glycogen from the adipose tissue, whereas plasma trehalose contained 1.2% of the injected activity. (CA 61: 1964, 7422a)

46 Chino, H., Gilbert, L.I. STUDIES ON THE INTERCONVERSION OF CARBOHYDRATE AND FATTY ACID IN Hyalophora cecropia. J. Insect Physiol. 11 (1965) 287-95.

The interconversion and catabolism of fatty acid and carbohydrate were studied in H. cecropia during pupal-adult development. There was no detectable conversion of (1-^{14}C)-palmitate or (1-^{14}C)-acetate into carbohydrate (glycogen and trehalose). However, the label from ^{14}C-glucose was recovered in long-chain fatty acid glycerides. An appreciable quantity of radioactivity from uniform-^{14}C-glucose was recovered in glycogen. There was no appreciable difference in the incorporation or the breakdown of palmitate, acetate, or glucose between male and female except that the incorporation of ^{14}C-glucose into glycogen in the female exceeded that in the male during later developmental stages. A large portion of ^{14}C-palmitate but only a small amount of ^{14}C-acetate was incorporated into the neutral fat fraction. (Auth.)

47 Heslop, J.P. THE IRREVERSIBLE NATURE OF GLYCOLYSIS IN THE HOUSEFLY, Musca domestica. Biochem. J. 95 (1965) 40p.

Adult houseflies were injected with 1 μCi of aqueous [2-^{14}C]acetate (30 μM/g of fly) in 1 μl. Thoracic extracts, prepared 30 min after injection, were chromatographed and showed a similar pattern of labelling to the whole fly extracts of Price*. Only small traces of radioactivity coincided with added trehalose or glycerol 1-phosphate. Perchloric acid extracts were made from thoraces and abdomina of flies labelled for 1 h with 1 μCi of [U-^{14}C] pyruvate (12 μM/g). Amino acids were removed from the extracts. The amounts of ^{14}C that were found in glycogen (prepared from whole flies), trehalose and glycerol 1-phosphate, although readily detectable were too small for accurate measurement. Experiments indicated the existence of a highly active, soluble fructose diphosphatase in houseflies, implying that the glycolytic pathway should be reversible from hexose diphosphate. The finding that injection of [^{14}C]glycerol into flies causes intense labelling of hexoses (R. G. Bridges, personal communication to the author) supports this conclusion.

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* Biochem. J. 80: 1961,420.

48 Lambremont, E.N. THE METABOLISM OF GLUCOSE AND ITS CONVERSION INTO LONG-CHAIN FATTY ACIDS BY THE BOLL WEEVIL. Bull. ent. Soc. Am. 11, 3 (1965) 159. Abstr.89 Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Glucose and related carbohydrates are important precursors of the acetate units from which boll weevils synthesize fatty acids. A significant portion of injected ^{14}C- labelled glucose is concurrently converted to $^{14}CO_2$. The route of conversion of glucose to $^{14}CO_2$ and to fatty acid has been studied using variously labelled intermediates. (Abstr.)

49 Lipke, H., Graves, B., Leto, S. POLYSACCHARIDE AND GLYCOPROTEIN FORMATION IN THE COCKROACH. II. INCORPORATION OF D-GLUCOSE-^{14}C INTO BOUND CARBOHYDRATE. J. biol. Chem. 240, 2 (1965) 601-8.

The metabolism of polysaccharide and of glycoprotein-bound hexosamine and neutral sugar was studied in the tissues of the intact nymph during moulting. Following the injection of either uniformly labelled D-glucose- or D-glucose-1-^{14}C, the specific activity of cuticle D-glucosamine was 3 - 10 times higher than that of carbohydrate bound as plasma glycoprotein, fat-body glycoprotein, fat body glycogen, or in the wall of the proventriculus. Throughout the moult cycle, only free plasma trehalose acquired sufficient radioactivity to qualify as a precursor of chitin. Amino acids, lipid, and the N-acetyl group of chitin showed low specific activity compared to the glucosaminyl moiety of the cuticle glucosamine. Synthesis and degradation of cuticle polysaccharide was continuous throughout the moult cycle, although the two processes varied in relative magnitude according to the stage. The rate of incorporation of glucose into chitin varied from a value of 12.5 μM/d early in the moult cycle to 4.7 μM/d in the middle of the moult cycle. For these same moult stages the rates of glucosamine removal from the cuticle were 9.2 μM/d and 3.2 μM/d, respectively. The period between moults is characterized by an average rate of addition of bound neutral sugar to the cuticle of 0.26 μM/d and a rate of removal of 0.20 μM/d. Following the administration of glucose-1-^{14}C, about 80% of the label was recovered from C atom 1 of the glucosaminyl residue of the chitin when the period of incorporation was short. The pattern of isotope accumulation in the hexosamine moiety of the plasma and fat body glycoprotein suggested periods of little or no turnover and other periods when significant rates were manifest. In the middle of the moult cycle, $t_{\frac{1}{2}}$ was 16 d for fat body hexosamine and 29 d for plasma hexosamine with no obvious precursor-product relation between the two compartments. For plasma trehalose, $t_{\frac{1}{2}}$ was 0.37 d. The conversion of 1-^{14}C-glucosamine, and N-acetyglucosamine to labelled carbon dioxide was observed, suggesting the recycling of cuticle constituents following resorption of the integument. (From auth.)

50 Payne, D.W., Evans, W.A.L. TRANSGLYCOSYLATION IN THE DESERT LOCUST, Schistocerca gregaria Forsk. J. Insect Physiol. 10, 5 (1964) 675-88.

The hydrolysis of maltose, sucrose, methyl α-glucopyranoside, cellobiose, and raffinose by a freeze-dried enzyme preparation of the foregut and midgut contents of the desert locust S. gregaria is accompanied by transglycosylation. The transglycosylation products were identified as far as possible by comparing their Rg values with those of authentic markers and by the use of specific paper partition chromatogram development techniques. In addition to glucose, maltose digests contained isomaltose, panose, maltotriose, and two other unidentified oligosaccharides which were probably of the panose series. Maltose reformation was detected by the incorporation of [^{14}C] glucose into maltose. Transglucosylation in maltose digests can explain the apparent loss of reducing sugar when incubated maltose reaction mixtures samples are fractionated on activated carbon columns. (Auth.)

51 Sridhara, S., Bhat, J.V. INTERCONVERSION OF CARBOHYDRATE AND FAT IN THE SILKWORM Bombyx mori L. Life Sci. 4, 9 (1965) 979-82.

Mature silkworm larvae, 3-4 d prior to spinning, were injected with palmitic acid-1-^{14}C and glucose-U-^{14}C. Glycogen isolated after 24 h, 48 h, 7 d, and 14 d of administering palmitic acid-1-^{14}C was found not to contain any radioactivity thus indicating that there was no conversion of fatty acid to carbohydrate in this insect. This and other results lead to the conclusion that fatty acids do not serve as the source of energy for B. mori.

See also:

37 Données biochimiques et histochimiques sur l'incorporation du sulfate de sodium radioactif, chez Gryllus bimaculatus de Geer (Insecte, Orthoptère). (Martoja, R., 1964)
139 Cytochemical investigation of silk glands in Antheraea pernyi. (Makarov, P.V., 1965)
235 Carbohydrate-amino acid conversions during cuticle synthesis in Periplaneta americana. (Lipke, H. et al., 1965)
240 Incorporation of H^3-D-glucose during oogenesis in Apis mellifica L. (Engels, W., Drescher, W., 1964)
246 Intermediary metabolism and the insect fat body. (Kilby, B.A., 1965)
270 Flight exhaustion studies on the blow fly Phaenicia sericata using C^{14}-labeled sucrose. (Yurkiewicz, W.J., 1965)
271 The assimilation of acetate and propionate by Prototheca zopfii. (Lloyd, D., Callely, A.G., 1965)
408 The effect of malathion on the catabolism of labelled glucose in Blattella germanica (L.). (Mansingh, A., 1964)

4. Amino Acids. Pteridines, Pyrimidines, Purines. Proteins. Enzymes. Hormones

52 Brunet, P.C. THE METABOLISM OF AROMATIC COMPOUNDS. p.49-77 of "Aspects of Insect Biochemistry. Biochemical Society Symposium No.25, London, 1 Apr. 1965". Godwin, T.W., Ed. London, Academic Press. 1965, 107p.

After discussing the requirements and intake of aromatic amino acids the author deals with the products of the metabolism of tyrosine and phenylalanine and their biological function. The section is broken down into discussions of proteins in which aromatic amino acids are incorporated: the resilins which are elastic cross-linked proteins, and sclerotin, a rigid cross-linked protein. Frequent use was made of radioisotopes in studies on quinone tanning and quinone-tanning agents. The metabolism of tyrosine and phenylalanine, and the metabolic pathways and products of tryptophan are all considered at some length. Radioisotopes were involved in numerous studies.

53 Akai, H., Kobayashi, M. SITES OF FIBROIN FORMATION IN THE SILK GLAND IN Bombyx mori. Nature, Lond. 206 (1965) 529.

Glycine-2-^{3}H was injected through the mouth into the digestive tract of 5th-instar 4-d-old larvae by means of a microsyringe. The silk gland was dissected out 15 min later. Results obtained by electron microscopic autoradiography showed that labelled glycine was incorporated into the rough endoplasmic reticulum for fibroin formation within 15 min of glycine ingestion. Newly synthesized, radioactive fibroin is subsequently transported to the Golgi region and concentrated there.

54 Ammon, H., Karlson, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XIV. RADIO-AUTOGRAPHISCHE LOKALISATION DER SKLEROTISIERUNGSSUBSTANZ IN PUPPENTÖNNCHEN VON Calliphora erythrocephala. (Tyrosine metabolism in insects. XIV. Autoradiographic localization of tanning agent in the puparium of Calliphora erythrocephala). J. Insect Physiol. 10, 3 (1964) 525-7. (In German, with English summary)

When labelled tyrosine, dopamine, or N-acetyl-dopamine is injected into mature larvae of C. erythrocephala, the radioactivity appears mainly in the sclerotized parts of the puparium. There is no difference in the picture after administration of (α-^{14}C)-dopamine or N-[1-^{14}C-acetyl]-dopamine. It is concluded that the tanning agent, i.e. N-acetyl-dopamine, is incorporated as a whole entity. The tanning agent is also present though in lower concentration in the outer endocuticle. It is presumably transported from the haemolymph through the epidermal cells into the exocuticle. This renders the concept of "self-tanning cuticular proteins" unlikely. (Auth.)

55 Baliga, B.S., Srinivasan, P.R., Borek, E. CHANGES IN THE t-RNA METHYLATING ENZYMES DURING INSECT METAMORPHOSIS. Nature, Lond. 208 (1965) 555-7.

RNA and DNA methylases are species specific. In a study involving the cycle of metamorphosis in Tenebrio molitor alterations were found to occur in the t-RNA methylases not only at the transition from larva to pupa but also throughout the duration of the pupal stage right up to the emergence of the imago. Enzyme extracts were prepared from larvae or pupae. Methylase activity of the extracts was assayed by measuring the incorporation of ^{14}C-methyl from [methyl-^{14}C]-s-adenosyl-L-methionine into methyl-deficient Escherichia coli t-RNA (Fig. 1). Marked changes occurred in the activity of the t-RNA methylases almost daily within the pupae. A reproducible pattern of enzyme activity was obtained. A minimal activity on the 3rd day was followed by a maximum on the 4th. On the 7th day, just prior to the emergence of the beetle, enzyme activity proved at its lowest. The extent of methylation of the substrate was measured (Fig. 2). Large differences in total enzyme activity were apparent. Between the 1st and 7th day in the life of a pupa a ~ 50% reduction of enzyme activity occurs. The almost daily alterations in RNA methylase levels during the pupal stage are highly suggestive of some basic function. The t-RNA methylases alter the structure of one of the cardinal components of the protein synthesizing machinery of the cell.

56 Beermann, W. STRUCTURE AND FUNCTION OF INTERPHASE CHROMOSOMES. p.375-83 of "Genetics Today. Proceedings of the 11th International Congress of Genetics, The Hague, Netherlands, Sep. 1963, Vol.2". Geerts, S.J., Ed. Oxford, Pergamon Press. 1965.

Review article. Reference is also made to studies using ^{14}C-labelled precursors of proteins and RNA in chironomids. (See also p.387 of B.P. Kaufmann's "Synthesis")

57 Bloch, D.P., Brack, S.D. CYTOPLASMIC SYNTHESIS OF NUCLEAR HISTONE DURING SPERMIOGENESIS IN THE GRASSHOPPER Chortophaga viridifasciata (de Geer). J. Cell Biol. 22, 2 (1964) 327-40.

Histone synthesis during spermiogenesis was studied by means of autoradiographic and cytochemical methods. Labelled material (from 2-10 μl of ^{3}H-thymidine, ^{3}H-cytidine, or ^{3}H-arginine in doses of 1, 10 and 25 μCi, respectively) was injected into anaesthetized animals, usually nymphs, at the third segment. It was found that meiosis is followed by a cessation of RNA synthesis, an elimination of RNA from the nucleus, and, during the cytoplasmic sloughing accompanying the initial cytoplasmic elongation, a loss of most of the RNA from the cell. The initial phase of cell elongation results in a long spermatid headed by a spherical RNA-less nucleus bounded by a thin RNA-containing layer of cytoplasm. Subsequent nuclear elongation is accompanied by a replacement of the typical histones by others rich in arginine. This replacement is the result of synthesis of new protein. Incorporation of arginine is first seen to occur in the thin cytoplasmic layer surrounding the nucleus. This layer was shown by staining and electron microscopy to contain aggregations of ribosome-like particles. These observations support the conclusion that the histone is synthesized in association with the RNA granules in the cytoplasm, then migrates into the nucleus where it combines with the DNA.

58 Brenner-Holzach, O., Leuthardt, F. BIOSYNTHESIS OF PTERINS IN Drosophila melanogaster. III. ORIGIN OF THE SIDECHAIN IN DROSOPTERIN. Helv. chim. Acta 48, 7 (1965) 1569-78. (In German)

Drosopterin (I) and isoxanthopterin (II) isolated from extracts of hatched D. melanogaster larvae which had been fed glucose-1-^{14}C (III) had the same specific activity, whereas after feeding with glucose-U^{14}C or glucose-6-^{14}C (IV), I had a larger activity than did II. C-8 and C-9 obtained from II as CaC$_2$O$_4$ after degradation of the pterin with Cl, contained much more ^{14}C after the administration of III than after IV. Terminal C atoms of I extracted from flies after administration of IV contained twice the activity found when the larvae were fed III. I synthesized in the presence of glucose-2-^{14}C (V) contained most of the activity in the pteridine skeleton. HOAc obtained from I synthesized in the presence of IV or III contained most of the radioactivity in C-2, whereas synthesis in the presence of V produced greater activity in C-1. A close relation existed between the side chain of I and C-4 and C-6 of glucose. (CA 63; 1965, 18715-cd)

59 Brosemer, R.W. THE EFFECT OF PUROMYCIN AND ACTINOMYCIN D ON THE DEVELOPMENT OF GRASSHOPPER FLIGHT MUSCLE GLYCEROLPHOSPHATE DEHYDROGENASE. Biochim. biophys. Acta 99, 2 (1965) 388-90.

Grasshoppers (Melanoplus differentialis and Schistocerca vaga) were reared. Antibiotics were injected into newly moulted adults and the effect on glycerolphosphate dehydrogenase specific activity measured. The range of antibiotic dosage which produced a significant effect on dehydrogenase specific activity proved relatively narrow, ~ 1-4 μg actinomycin D/g body wt. and 1-4 mg puromycin/g body wt. In order to confirm that actinomycin D and puromycin inhibit muscle protein synthesis under these conditions, [^{14}C] valine or [1-^{14}C] leucine was also injected and the incorporation of label into muscle protein determined. The results indicate that puromycin affects enzyme development only under conditions where it simultaneously inhibits protein synthesis. Actinomycin D also inhibits protein synthesis when dehydrogenase specific activity increase is blocked. The increase in flight muscle glycerolphosphate dehydrogenase after the last moult is therefore due to net enzyme synthesis de novo, not activation of pre-existing apoenzyme. Present results are consistent with the hypothesis that ecdysone also controls the synthesis of glycerolphosphate dehydrogenase in developing insect muscle.

60 Bücher, Th. FORMATION OF THE SPECIFIC STRUCTURAL AND ENZYMIC PATTERN OF THE INSECT FLIGHT MUSCLE. p.15-28 of "Aspects of Insect Biochemistry. Biochemical Society Symposium No. 25, London, 1 Apr. 1965". Goodwin, T.W., Ed. London, Academic Press. 1965, 107p.

Radioisotopes have been used in studying mitochondria which are reponsible for the extreme respiratory rate of flight muscle during activity. Locusta migratoria was used. Cited studies* show that the process of formation of these mitochondria can be observed in vitro by measuring the incorporation of labelled amino acids ([^{14}C] isoleucine). The incorporation rate into isolated mitochondria in vitro is found to be dependent on the stage of development of the muscle from which the mitochondria have been isolated. The amino acids are incorporated in vitro only into the non-extractable part of the mitochondrial protein, possibly the structural protein, whereas the easily extractable proteins of the mitochondria are labelled only when the amino acids are administered in vivo. Accordingly, mitochondrial growth depends on co-operation with extra-mitochondrial ribosomes; mitochondria in the essential phases of growth are, in fact, densely surrounded by polysomes. Interfibrillar tracheoles and myofibrils, and their growth are discussed.

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* Papers presented by U. Bronsert and H. Schott, and by W. Neupert and Th. Bücher at the "Herbsttagung der Gesellschaft für Physiologische Chemie, Cologne, Federal Republic of Germany".

61 Clever, U. ACTINOMYCIN AND PUROMYCIN: EFFECTS ON SEQUENTIAL GENE ACTIVATION BY ECDYSONE. Science, N.Y. 146 (1964) 794-5.

A temporary inhibition of RNA synthesis leads to a corresponding delay in the formation of all puffs which are stimulated by ecdysone in the salivary gland chromosomes of Chironomus tentans. Inhibition of protein synthesis does not influence the induction of those puffs which appear shortly after injection of ecdysone. Puffs which develop after a longer period are delayed in appearance. It is concluded that early reacting genes are involved in those processes leading to the sequential activation of the puffs which appear later. ^{3}H-uridine (1.29 Ci/mM; 1.0 μCi/ml) was used. (Essentially auth.)

62 Das, C.C., Kaufmann, B.P., Gay, H. AUTORADIOGRAPHIC EVIDENCE OF SYNTHESIS OF AN ARGININE-RICH HISTONE DURING SPERMIOGENESIS IN Drosophila melanogaster. Nature, Lond. 204, 4962 (1964) 1008-9.

Microscopic examination of testes offers clear evidence that ^{3}H-arginine is incorporated into the nuclei of mature spermatozoa. This distribution parallels that of arginine-rich histone as revealed by alkaline Fast Green stainability after deamination. The uptake increases as the time and temperature of treatment increase. Puromycin is an inhibitor of the process. (CA 62 : 1965,5615h)

63 Emmerich, H., Drews, G., Trautmann, K., Schmialek, P. ÜBER DEN STOFFWECHSEL DES FARNESOLS IN Tenebrio molitor-LARVEN. (Farnesol metabolism in Tenebrio molitor larvae). Z. Naturf. 20b, 3 (1965) 211-3. (In German)

Farnesol and some of its derivatives have the same morphological and physiological effects as juvenile hormones. Farnesol degradation was studied by means of optical tests and metabolites formed from 1,2-^{14}C-farnesol. As had already been shown in rat liver homogenates, the reaction sequence is farnesol → farnesal → "farnesenic" acid (Farnesensäure). Possible alternative metabolic pathways are discussed.

64 Filippovich, Yu. B. THE BIOSYNTHESIS MECHANISM OF SILK FIBROIN. Usp. sovrem. Biol. 57, 2 (1964) 192-210.

A review with numerous references, some of them dealing with radioisotope studies.

65 Frontali, N. BRAIN GLUTAMIC ACID DECARBOXYLASE AND SYNTHESIS OF γ-AMINOBUTYRIC ACID IN VERTEBRATE AND INVERTEBRATE SPECIES. p.185-92 of "Comparative Neurochemistry. Proceedings of the 5th International Neurochemical Symposium, St. Wolfgang, Austria, 1962". Richter, D., Ed. Oxford, Pergamon Press. 1964.

^{14}C-L-glutamic acid (0.3 μCi/μM) was used in a method for the simultaneous determination of the CO_2 and γ-aminobutyric acid production from glutamic acid in nervous tissue preparations. Tissue from different species, including Apis mellifica, was examined under a variety of conditions. Discrepancies between the production of γ-aminobutyric acid and of CO_2 were demonstrated in two instances – at the higher of two pH optima and in subcellular fractions. A quantitative analysis of the free amino acids of the honeybee brain is appended.

66 Goto, M., Okada, T., Forrest, H.S. BIOSYNTHESIS OF DROSOPTERIN IN THE EYE PIGMENT OF Drosophila melanogaster. Seikagaku Zasshi (J. Biochem., Tokyo) 56, 4 (1964) 379.

^{14}C-labelled 2-amino-6-hydroxy-7,8,9,10-tetrahydropteridine (I), first fed to 100 larvae then extracted from 80 hatched flies, was shown to be a precursor of drosopterin of D. melanogaster. The distribution of radioactivity between isoxanthopterin, drosopterin, and 2-amino-6-hydroxypterin was 70,20, and 10%, respectively. The microsynthesis of I from 2,4,5-triamino-6-hydroxypyrimidine sulphate monohydrate-5-^{14}C was described. (CA 62 : 1965,2020f)

67 Goto, M., Okada, T., Forrest, H.S. SYNTHESIS OF 2-AMINO-4-HYDROXY-6-(D-ERYTHRO-1',2',3'-TRIHYDROXYPROPYL) PTERIDINE-3'-PHOSPHATE-10-^{14}C, AND ITS METABOLISM IN Drosophila melanogaster. Archs Biochem. Biophys. 110 (1965) 409-12.

The synthesis of (2-amino-4-hydroxy-6-pteridinyl)-glycerol phosphate-10-^{14}C is reported. When this compound is reduced and then fed to D. melanogaster, the major radioactive component isolated is 2-amino-4-hydroxy-6-methylpteridine-10-^{14}C. (Auth.)

68 Hackman, R.H., Saxena, K.N. TYROSINE METABOLISM IN BLOWFLY LARVAE AT PUPATION. Aust. J. biol. Sci. 17, 3 (1964) 803-5.

Fully grown last instar larvae of Lucilia cuprina were injected with L-tyrosine-U-^{14}C (I) just before pupation. A small fraction of I is incorporated as such into the pupa. Most of the radioactivity is incorporated into the puparium, where it exists as phenolic material, probably derived from the compounds used to cross-link the protein to form the hard, dark puparium. Colour reactions indicate that this material is probably not composed of simple o-dihydric phenols. The remaining I is incorporated into a thin membrane which is insoluble in constant boiling HCl at 100°. It is suggested that this membrane is part of the outer epicuticle or paraffin layer. The stability of this membrane suggests that I may exist in the form of cross-linkages. (CA 62 : 1965,3127d)

69 Henry, S.M., Block, R.J., Cook, T.W. METHIONINE SULFOXIDE AND OTHER COMBINED AMINO ACIDS IN THE GERMAN COCKROACH. Adv. Chem. Ser. 44 (1964) 85-95.

Alkaline hydrolysis of cockroach residues subsequent to extraction under N with 80% EtOH yielded methionine and methionine sulphoxide in a ratio of 10 : 1. Additional evidence for the presence of combined methionine sulphoxide was obtained by measuring the amount of methionine sulphoxide-^{35}S in acid and enzymic hydrolyzates after assimilation of $Na_2{}^{35}SO_4$. The data are believed to be indicative of naturally occurring peptide- or polysaccharide-bound methionine sulphoxide. Other combined amino acids were determined by ion exchange of the 5% Cl_3CCO_2H-insoluble cockroach residues after hydrolysis with acid or alkali. Beta-alanine, normally present only in the soluble fraction of an organism, was found in the insoluble, proteinaceous residue. (CA 60 : 1964,14881e)

70 Hill, L. INCORPORATION OF C^{14}-GLYCINE INTO THE PROTEINS OF THE FAT BODY OF THE DESERT LOCUST DURING OVARIAN DEVELOPMENT. J. Insect Physiol. 11, 12 (1965) 1605-15.

The rate of incorporation of ^{14}C-glycine into the fat body proteins of the female desert locust depends upon the reproductive state of the animal. Before the start of oocyte development the rate of incorporation is low, but increases during the period of yolk deposition in the terminal oocytes and then decreases again at the end of oocyte development. This cyclic incorporation rate can thus be correlated with the cycles of oocyte growth and neuroendocrine activity. Cautery of the cerebral neurosecretory cells or allatectomy results in a lowered incorporation rate and the implanation of a corpus cardiacum increases the incorporation rate. It is concluded that the rate of incorporation of ^{14}C-glycine into the fat body proteins is related to the rate of protein synthesis by the fat body and that this process is under neuroendocrine control. The role of the neurosecretory system in this process is discussed in relation to its further role in the control of water balance. (Auth.)

71 Happ, G.M., Meinwald, J. BIOSYNTHESIS OF ARTHROPOD SECRETIONS. I. MONOTERPENE SYNTHESIS IN AN ANT (Acanthomyops claviger). J. Am. chem. Soc. 87, 11 (1965) 2507-8.

Groups of 1000-1500 worker ants were fed portions of Na acetate-1-^{14}C, Na acetate-2-^{14}C, and mevalonic-2-^{14}C lactone. After 7-10 d the ants were frozen and extracted with CH_2Cl_2. Thin-layer chromatographic purification suggested that the normal mevalonic acid pathway of terpene biosynthesis is utilized. (CA 63 : 1965,7399g)

72 Hoffmeister, H. KONSTITUTIONSAUFKLÄRUNG DES ECDYSONS. (Elucidation of the structure of ecdysone). Thesis. Naturwissenschaftliche Fakultät, Ludwig-Maximilians-Universität. Munich 1963, 53p. (In German)

A mol. wt. of 464 and a summation formula of $C_{27}H_{44}O_6$ were determined. Ecdysone was found to belong to the steroid hormones. Structural details were obtained from chemical, biochemical and spectroscopic analyses. The biosynthesis of ecdysone in the insect organism starts with the precursor cholesterin. Following the injection of ^{3}H-cholesterin into Calliphora larvae, ^{3}H-ecdysone was isolated.

73 Kamon, E. DISTRIBUTION OF SCORPION VENOM IN LOCUSTS. J. Insect Physiol. 11, 7 (1965) 933-45.

Redissolved freeze-dried venom of Leiurus quinquestriatus H. & E. was labelled with ^{131}I, and injected into adults of Locusta migratoria migratorioides R. & F. which were dissected at intervals of 5 min - 216 h following injection. Radioactivity was measured separately for cell-free haemolymph, circulating haemocytes (obtained by centrifugation), intestine, fat body, muscles, thorax, reproductive system, pericardial cells, Malpighian tubules, faeces, central nervous system, and remaining body parts including body wall, legs, and wings. Two counts were taken for each dissected part, the first immediately following dissection and the second after rinsing the tissue in saline. The difference in radioactivity before and after rinsing indicated that 20-30% of the venom was rinsed out. Part of this was undoubtedly venom from haemolymph adhering to the dissected tissues. A significant part of the venom (about 25%) was found to be absorbed by the pericardial cells. Percentage radioactivity for each consecutive 24 h collection of pellets was: 50.80, 8.42, 4.45, 1.39, 0.97, and 0.59 respectively. With time, most tissues showed a decline in radioactivity, except the cuticular parts of the body where percentage radioactivity remained constant from 5 min - 216 h following injection of labelled venom. (Auth.)

74 Karlson, P. BIOCHEMICAL STUDIES OF ECDYSONE CONTROL OF CHROMOSOMAL ACTIVITY. J. cell. comp. Physiol. 66, 2/II (1965) 69-76 (discussion 71-74).

The production of puffs in the salivary gland chromosomes of the midge Chironomus have been investigated. In the blowfly Calliphora the synthesis of messenger RNA has been demonstrated; this messenger carries the information for the enzyme dopa decarboxylase. The enzyme is induced in vivo by ecdysone; the induction can be inhibited by actinomycin, puromycin, and other inhibitors of RNA and protein synthesis. Dopa decarboxylase is one of the key enzymes in the process of sclerotization, in which tyrosine metabolites are incorporated into the cuticle, resulting in tanning. All steps from gene activation through RNA and protein synthesis to the final physiological response have therefore been demonstrated experimentally. Radioisotopes were used to elucidate many of the processes cited in this review.

75 Karlson, P., Herrlich, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XVI. DER TYROSINSTOFFWECHSEL DER HEUSCHRECKE Schistocerca gregaria Forsk. (Tyrosine metabolism in insects. XVI. Tyrosine metabolism in the locust Schistocerca gregaria Forsk). J. Insect Physiol. 11, 1 (1965) 79-89. (In German, with English summary)

In Schistocerca tyrosine is metabolized by two main pathways. Catabolism is initiated by transamination and the resulting p-hydroxyphenylpyruvate is then converted to p-hydroxyphenylpropionate and p-hydroxybenzoate. The second pathway leads to tyramine and dopamine, the precursors of the tanning agents; these amines are then N-acetylated. The fate of tyrosine depends on the stage of development. Between the moults, phenolic acids are the main metabolites. Production of dopamine and tyramine prevails at the moult; the activity of the corresponding decarboxylases shows maxima shortly before and after moulting. The following radioactive compounds were used: generally ^{14}C-labelled tyrosine, β-[3,4-dihydroxyphenyl]-alanine-α-^{14}C (= dopa), β-[4-hydroxyphenyl]-ethylamine-α-^{14}C (tyramine), β-[3,4-dihydroxyphenyl]-ethylamine-α-^{14}C (= dopamine), and generally ^{14}C-labelled p-hydroxyphenylpropionic acid obtained on incubating generally ^{14}C-labelled tyrosine with Calliphora homogenates.

76 Karlson, P., Peters, G. ZUM WIRKUNGSMECHANISMUS DER HORMONE. IV. DER EINFLUSS DES ECDYSONS AUF DEN NUCLEINSÄURESTOFFWECHSEL VON Calliphora-LARVEN. (The mechanism of action of hormones. IV. The effect of ecdysone on nucleic acid metabolism in Calliphora larvae). Gen. comp. Endocr. 5, 2(1965)252-9. (In German, with English abstr.)

Injection of ecdysone into larvae of C. erythrocephala results in the stimulation of RNA turnover. ^{32}P-orthophosphate was used. By 4-7 h after hormone injection, the incorporation of inorganic phosphate into RNA has increased by 50-80%. The results corroborate the postulated mechanism of hormone action via activation of genes and stimulation of messenger-RNA synthesis.

77 Karlson, P., Mergenhagen, D., Sekeris, C.E. TYROSINE METABOLISM IN INSECTS. XV. THE o-DIPHENOL OXIDASE SYSTEM IN Calliphora erythrocephala. Hoppe-Seyler's Z. physiol. Chem. 338, 1/2 (1964) 42-50. (In German, with English summary)

Haemolymph from C. erythrocephala larvae was taken up in phosphate buffer, centrifuged, and fractionated with $(NH_4)_2SO_4$. The fraction obtained was then chromatographed on Sephadex G-50.

The purity of the purified pre-enzyme was examined by paper chromatography and analytical ultracentrifugation. The $s_{20,w}$ of the main peak was 15.4 S. The diphenol oxidase activity was determined with 2,4-dihydroxyphenylalanine as substrate and measuring the increase in absorbance at 480 mμ. A crude preparation of the activator-enzyme was obtained by extraction of acetone powder with a dilute ascorbic acid solution with subsequent centrifugation and filtration over Sephadex G-50. A highly purified preparation was obtained from fresh larvae cuticles with a dilute ascorbic acid solution and fractionation of the extract with $(NH_4)_2SO_4$. The activation-time curves of the pre-enzyme in crude homogenates were sigmoidal, whereas those of purified preparations showed an initial, rapid increase leveling off with time, which does not seem to indicate autocatalysis. Activation of the pre-enzyme in the presence of mitochondria resulted in adsorption of the active enzyme on the mitochondria under which circumstances the enzyme also displayed a high tyrosine hydroxylase activity, as measured by the incorporation of radioactivity from tyrosine-^{14}C into 2,4-dihydroxyphenylalanine. (CA 61:1964,15087d)

78 Karlson, P., Sekeris, C.E., Maurer, R. ZUM WIRKUNGSMECHANISMUS DER HORMONE. I. VERTEILUNG VON TRITIUM-MARKIERTEM ECDYSON IN LARVEN VON Calliphora erythrocephala. (The mechanism of action of hormones. I. Distribution of tritium-labelled ecdysone in larvae of Calliphora erythrocephala. Hoppe-Seyler's Z. physiol. Chem. 336, 1/3 (1964) 100-6. (In German, with English summary).

The distribution of ^{3}H-ecdysone in the haemolymph, epidermis, and fat body of Calliphora larvae in the final stadium was followed. The max. concentration in the epidermis was obtained 1 h after injection, whereas the fat body showed a more gradual increase. In ligated animals (ecdysone-deficient animals), the incorporation into the epidermis was retarded. In the fat body, most of the activity is localized in the microsome fraction while in the epidermis, a large amount appears in cell nuclei. This supports the authors' hypothesis that hormones function via gene activation and enzyme induction.

79 Kasting, R., McGinnis, A.J. AMINO ACID REQUIREMENTS FOR THE WHEAT STEM SAWFLY DETERMINED WITH GLUCOSE-U-C^{14} AFTER VACUUM-INFILTRATION. Can. Ent. 96, 8 (1964) 1133-7.

Glucose-U-^{14}C was incorporated into immature larvae of the wheat stem sawfly, Cephus cinctus Nort., by vacuum-infiltration. These insects were too small to be conveniently injected and could not be easily fed on artificial diets. About half of them survived the infiltration treatment. $^{14}CO_2$ was produced by the organism showing that the radioactive substrate was metabolized. Of the amino acids isolated from the larvae, proline, alanine, glutamic acid, serine, aspartic acid, and glycine contained relatively large quantities of ^{14}C indicating biosynthesis, and are classed as nutritionally non-essential. In contrast, arginine, isoleucine, leucine, lysine, phenylalanine, threonine, tyrosine, and valine contained little, if any, radioactivity and are classed as nutritionally essential. The concentrations of some of the amino acids in the larval tissues are also presented. (Auth.)

80(2) Kobayashi, M. THE CHEMISTRY AND PHYSIOLOGY OF THE BRAIN HORMONE. p.226-33 of "Proceedings of the 16th International Congress of Zoology, Washington, D.C., 20-27 Aug. 1963, Vol. 4". Moore, J.A., Ed. Washington, D.C., 16 International Congress of Zoology. 1963.

The author discusses the location and action of neurosecretory cells in the brain, the hormonal system of growth and development, the physiology of metamorphosis, and the extraction, crystallization, and chemical character of the brain hormone. Purified brain hormone has been shown to be identical with pure cholesterol, the main sterol of most insects. While ^{14}C-acetate was incorporated into digitonide in the prepupal and pupal stages, it was incorporated very weakly (if at all) in the larval stage of Bombyx mori. The "Dauer-pupa" (30-d-old) was effectively unable to synthesize sterol from ^{14}C-acetate.

81 Lunan, K.D., Mitchell, H.K. TYROSINE METABOLISM AND TYROSINE-O-PHOSPHATE IN Drosophila. Fedn Proc. Fedn Am. Socs exp. Biol. 23, 2 Pt.I (1964) 370. "48th Annual Meeting, Chicago, 12-17 April 1964". Abstr. 1618.

Extracts of early Drosophila pupae rapidly metabolize large amounts of L-tyrosine at 30°C. The reactions are easily studied at 0°C by incubation with L-tyrosine-U-^{14}C: by 15 min, the protein fraction contained 22% of the added ^{14}C; no more label was incorporated. This material could be released by acid hydrolysis and was not tyrosine. By 35 min, 58% of the added tyrosine was converted to soluble non-tyrosine material; 1/3 of this was L-DOPA. The amount of pupal extract was rate-limiting. Tyrosinase was present but melanin was not formed. Extracts of late larvae carried out similar reactions. From such incubations, 3 alcohol-soluble ninhydrin-positive compounds were formed; their isolation is in progress. Also, tyrosine-O-phosphate was isolated from late larvae and characterized by several physical and chemical criteria. This compound accumulated slowly to a peak of 6.4 μM/g larvae at 105 h. Within 1 h, at the time of puparium formation, the level dropped to 0.6 μM/g. Chromatographic data indicate that ATP is required for the formation of this compound by larval extracts. These observations suggest that tyrosine plays a critical role in the metabolism of Drosophila. (Abstr.)

82 Makarov, P.V. AUTORADIOGRAPHIC STUDY OF PROTEIN-PRODUCING CELLS. Arkh. Anat. Gistol. Embriol. 48, 4 (1965) 3-16. (In Russian)

The incorporation of different precursors into nucleic acids and proteins of the spinning glands of Antheraea pernyi and the oocytes of Rana temporaria was investigated. In A. pernyi thymidine-^3H was detected in nuclear DNA 3h after administration, showing a markedly uneven distribution in different nuclei. The number of labelled nuclei decreased after 24 h. Adenine-^{14}C (I) was incorporated mainly into RNA (controls with RNase or N HCl treatment). Incorporation increased up to 72 h, being on the average 2-fold higher in nuclei than in cytoplasm, but parallel in both cellular parts. Similar correlations were observed after incubation of isolated glands in solutions containing I. Glands labelled in vivo for 24 h (2 μCi I per g body wt.) lost half of the RNA label during 1 h of subsequent incubation in vitro. Incorporation of glycine-^{14}C (II) and methionine-^{14}C into proteins increased for 24 h in vivo and 2 h in vitro, with incorporation into cytoplasm prevailing. The labelling of medium (350-500 μm diam.) and large (800-900 μm diam.) oocytes of R. temporaria was compared. Incorporation of I into nuclear RNA of both types of cells increased up to 72 h with no further change for 7 d. Nucleoli of the large oocytes showed higher labelling than the nucleoplasm. The label in the cytoplasm of these cells was resistant to RNase or N HCl extraction. In the cytoplasm of medium oocytes, I was found mainly in RNA. II was incorporated more intensively into large oocytes. Labelling of cytoplasmic proteins increased for 48 h, being 10 times higher in the large oocytes. Incorporation of II into nuclear proteins was the same for both cellular types. The results are discussed in detail; the absence of correlation between RNA content and protein synthesis is stressed. (CA 63: 1965, 8782 h)

83 Mansingh, A. GLYCINE CATABOLISM IN Blattella germanica (L.) J. Insect Physiol. 11, 7 (1965) 1031-37.

Glycine-U-^{14}C was injected into the body cavity of German roaches and the catabolism of the amino acid was studied. At the end of 5 h, during which $^{14}CO_2$ was collected, the soluble and insoluble fractions of the body were obtained and further separated by column and paper chromatography. The radioactivity was recovered from $^{14}CO_2$ glucose, trehalose, glycogen, organic acids including glyoxylic acid, pyruvic acid, α-ketoglutarate, and oxalacetate; lipids, proteins, glutathione, amino acids, and excretion. The amino acids that incorporated the labelled carbon were: serine, alanine, aspartate, glutamate, glutamine-asparagine, and proline. Roaches administered with unlabelled glycine showed accumulation of uric acid in the fat bodies. The probable pathways of glycine catabolism in the roaches are discussed. It is concluded that the maintenance of the nitrogen-pool and the production of energy via Krebs' TCA cycle are the most important roles of glycine in the insect. (Auth.)

84 Mansingh, A. THE EFFECT OF MALATHION ON THE METABOLISM OF AMINO ACIDS IN THE GERMAN COCKROACH Blattella germanica. J. Insect Physiol. 11, 10 (1965) 1389-400.

The effect of malathion (I) intoxication of the free amino acids of the blood of susceptible and resistant strains of B. germanica was studied. The roaches were poisoned by releasing them for 40 min on a surface treated with (I) (0.46 μl of 95% technical grade/cm²). The poisoned roaches and the unpoisoned controls of S strain were kept in recovery jars at 30°C and 55% relative humidity. Intoxication with (I) did not affect the levels of most of the free amino acids of the blood, but glycine (II), glutamate (III), proline (IV), and glutamine (V) were depleted in the susceptible strain, and, except for V, were slightly reduced in the resistant strain. There was a direct positive correlation between the degree of intoxication, the external symptoms of

poisoning, and the depletion of these amino acids. While the depletion of IV appeared to be the consequence of increased utilization of III, the level of V was affected by the concentrations of the other three amino acids. Mild poisoning had no effect on the V concentration, but the administration of labelled II glycine-U-^{14}C or III glutamate-U-^{14}C increased the lowered level of V in the lethally intoxicated roaches. Studies with labelled amino acids revealed that depletion of the amino acids, along with glycogen, trehalose, and glucose, was a consequence of the increased activity of the Krebs cycle. The NH_3 liberated by the deamination of the amino acids was utilized in the synthesis of nontoxic metabolites, urea and uric acid. (Essentially CA 63: 1965, 18962 c)

85 Maragoudakis, M.E., King, T.E., Cheldelin, V.H. ACIDIC AMINO ACIDS FROM α-HYDROXY-γ-OXOGLUTARATE-^{14}C IN RAT LIVER AND LARVAE OF THE BLOWFLY, Sarcophaga bullata. Biochim. biophys. Acta 93, 3 (1964) 646-49.

Alpha-hydroxy-γ-oxoglutarate-^{14}C (I) was prepared from oxalomalate-^{14}C by acidifying to pH 3.0 with HCO_2H and evaporating. After purification by adsorption on Dowex-1 (formate) resin, and elution with 6 N HCO_2H, the product was assayed with glutamic dehydrogenase (II). The identity of I was established by chromatography of its 2,4-dinitrophenylhydrazone, by catalytic reduction to γ-hydroxyglutamate (III), and by reductive amination by II. I was incubated with rat liver and blowfly larvae homogenates in the presence of alanine, $(NH_4)_2SO_4$, NADH, $MgCl_2$, and phosphate buffer, pH 7.5, for 3 h at 30°C. The acidic amino acids aspartic, glutamic, and erythro- and threo-hydroxyglutamic were isolated by mear of a Dowex-1 (acetate) column and elution with HOAc. Both threo- and erythro-hydroxyglutamic acids were formed by rat liver, but only the erythro isomer was formed by the blowfly larvae. (CA 62: 1965, 9558 d)

86 Miura, Y., Iro, H., Sunaga, K., Ikeda, K., Moriyama, Y., Hasegawa, S. PROTEIN SYNTHESIS IN SILK GLANDS. V. RELATION OF RIBOSOMES TO ENDOPLASMIC RETICULUM DURING FIBROIN SYNTHESIS. Seikagaku Zasshi (J. Biochem., Tokyo) 55, 6 (1964) 623-28.

By density-gradient centrifugation, homogenates of the posterior silk glands were divided into six groups; their protein, RNA, and lipids were analysed before and after incubating at 37°. During incubation the ribosomes detached from the endoplasmic reticulum and glycine-^{14}C did not react with the secretory protein fraction. (CA 61: 1964, 7422 e)

87 Okada, T., Goto, M. SYNTHESES OF 2-AMINO-4-HYDROXY-6-(HYDROXYMETHYL) PTERIDINE-10-^{14}C AND 2-AMINO-4-HYDROXYPTERIDINE-10-^{14}C AND THEIR METABOLISM IN Drosophila melanogaster. Seikagaku Zasshi (J. Biochem., Tokyo) 58, 5 (1965) 458-62.

When D. melanogaster larvae were grown in a medium containing either 2 mg (1.5 mCi/mM) of labelled 2-amino-4-hydroxy-6-(hydroxymethyl)pteridine or 10 mg (1.5 mCi/mM) of labelled 2-amino-4-hydroxypteridine, the adult flies contained radioactive sepiapterin and isoxanthopterin. This evidence suggested a hypothetical biosynthetic pathway for the formation of pteridines in this organism. (CA 64: 1966, 5513 h)

88(2) Peakall, D.B. RATE OF INCORPORATION OF AMINO ACIDS INTO THE WEB PROTEINS OF THE SPIDER Araneus diadematus Cl. p. 13 of "Proceedings of the 16th International Congress of Zoology, Washington, D.C., 20-27 Aug. 1963, Vol. 1". Moore, J.A., Ed. Washington, D.C., 16 International Congress of Zoology, 1963.

The rate of appearance of labelled amino acids in the web proteins of A. diadematus Cl. is measured. The ^{14}C-alanine, ^{14}C-glucose or radioactive web protein were fed orally to the spider. The webs are digested, the number of counts of radioactive disintegrations per minute measured and the total N-content of the web determined. Thus it is possible to calculate the amount of incorporation of the labelled material that has taken place. The same procedure was used for thread that had been pulled from the spider. This method has the advantage that the time scale can be altered at will. Using either method the experiment can be carried out over a long period of time as the spider is not harmed. The effects of drugs such as physostigmine (1 mg/kg given orally) which is known to increase the production of thread and protein blocking drugs such as puromycin (100 mg/kg) were examined. The rate of production of web proteins was also studied at the glandular level. Spiders with active glands (activated by pulling of thread), resting and after being given drugs were examined. By slaughtering after various time intervals and staining for nucleic acids and proteins it was possible to follow the processes of production and secretion of web proteins. The rate of incorporation of amino acids into the web proteins and the passage of this protein to the spinnerets was studied more specifically by the use of autoradiography.

89 Peakall, D.B. EFFECTS OF CHOLINERGIC AND ANTOCHOLINERGIC DRUGS ON THE SYNTHESIS OF SILK FIBROINS OF SPIDERS. Comp. Biochem. Physiol. 12, 4 (1964) 465-70.

Alanine-^{14}C (I) was administrated orally to spiders (Araneus sericatus) and the radioactivity of the silk threads was determined. The rate of I incorporation into the silk was increased by pulling out the threads from the silk glands and by administration of physostigmine, carbachol (II), and para-oxon. The rate of I incorporation was not affected by atropine (III), homoatropine, or mecamylamine; its stimulation by II, however, was blocked by pretreatment with III. It is suggested that the silk-secreting gland is under cholinergic control. (CA 61: 1964, 9813 b)

90 Peakall, D.B. REGULATION OF THE SYNTHESIS OF SILK FIBROINS OF SPIDERS AT THE GLANDULAR LEVEL. Comp. Biochem. Physiol. 15, 4 (1965) 509-15.

Physostigmine (I) and carbachol (II) increased the rate of uptake of orally administered alanine-^{14}C (III) in the epithelium and lumen of the silk gland of Araneus sericatus, but did not alter the absorption from the hind intestine. III incorporation could be doubled in the isolated gland by I and II, and could be decreased to low levels by atropine (IV). In addition, the isolated gland was stimulated by re-emptying following removal of the cephalothorax; this peripheral regulatory mechanism was not inhibited by IV. (CA 63: 1965, 8783 e)

91 Pickett, C., Friend, W.G. NUTRITIONALLY ESSENTIAL AMINO ACIDS OF Rhodnius prolixus (Stål) DETERMINED WITH GLUCOSE-U-^{14}C. J. Insect Physiol. 11, 12 (1965) 1617-23.

Fifth-instar larvae of R. prolixus can synthesize the carbon chains of alanine, asparagine, cystine, glutamic acid, proline, and serine from glucose-U-^{14}C. The following amino acids contained no detectable radioactivity and are therefore classified as essential: arginine, glycine, histidine, isoleucine, leucine, lysine, phenylalanine, threonine, tryptophan, and valine. Although tyrosine showed no radioactivity it may be considered a non-essential amino acid because its synthesis from phenylalanine has been demonstrated in other insects. It is noteworthy that glycine is an essential amino acid for larvae of R. prolixus since it is non-essential for most other animals that have been tested. Proline was the only free amino acid in the haemolymph that was radioactive 48 h after glucose-U-^{14}C injections. (Auth.)

92 Platova, T.P. REVEALING OF INTERMEDIATE STAGES OF PROTEIN SYNTHESIS IN THE NUCLEI OF Drosophila melanogaster SALIVARY GLAND CELLS. Tsitologiya 7, 3 (1965) 318-25. (In Russian)

Protein synthesis in the salivary gland cells of larvae of D. melanogaster was studied by autoradiographic determination of lysine-^{14}C incorporation. Intermediate stages of protein synthesis (formation of acid-insoluble labile complexes of activated amino acids) were detected in the period of intensive growth and secretion of salivary glands. These labile complexes were detected in cytoplasm in the 2nd- and early 3rd-instar larvae, but not in the late 3rd instar. However, the labile complexes were detected in nuclei in the entire 3rd instar. Evidence of the presence of unstably attached amino acids in giant chromosomes was obtained. It was suggested that synthesis of chromosome proteins might be accomplished directly in the chromosome. (CA 63: 1965, 8784 b)

93 Porter, C.A., Jaworski, E.G. BIOSYNTHESIS OF CHITIN DURING VARIOUS STAGES IN THE METAMORPHOSIS OF Prodenia eridania. J. Insect Physiol. 11, 9 (1965) 1151-60.

The relationship between chitin content and activity of the chitin synthetase enzyme was investigated in final instar larvae and pupae. The chitin synthetase assay reaction mixtures contained 4×10^{-4} M uridine diphospho-N-acetylglucosamine (UDPAG)-^{14}C (5.81×10^4 dpm), 0.011 M N-acetylglucosamine (AG), 5 mg chitodextrin, and 1 ml of an enzyme preparation in a total volume of 1.25 ml. A correlation was found between changes in chitin concentration and activity of the enzyme. AG-^{14}C is incorporated into chitin when the particulate fraction from

Prodenia larvae is incubated with UDPAG-^{14}C. Radioactive chitodextrins and AG are liberated by partial hydrolysis of the insoluble residue and a portion of the chitodextrins is further digested to AG by chitinase. The liberation of considerably more radioactivity directly from the insoluble residue with chitinase than without chitinase is further evidence that chitin is synthesized during the incubation with UDPAG-^{14}C. The maximum level of chitin and the peak activity of the enzyme occur in the late final larvae. The concentrations of hexosamines and chitodextrins are discussed in relation to their possible significance in chitin biosynthesis.

94 Price, G.M. ASPECTS OF AMINO ACID AND NUCLEIC ACID METABOLISM IN THE LARVA OF THE BLOWFLY, Calliphora erythrocephala. Biochem. J. 95, 3 (1965) 39P-40P.

The distribution of free amino acids between the haemolymph, fat body, cutaneous muscle and cuticle of 4-d-old blowfly larvae was examined. The amino acid present in greatest amount in the fat body was tyrosine, followed by alanine and glutamine, which were the two amino acids present in greatest amounts in the other tissues. Aspartic acid was not discernible in haemolymph and glutamine acid and phenylalanine were present there in only trace amounts. Phenylalanine was absent from the cuticle, present in trace amounts in cutaneous muscle, and was easily discernible in the fat body. These observations regarding tyrosine and phenylalanine suggest that hydroxylation of phenylalanine to tyrosine may take place in the fat body. The large amount of tyrosine in the fat body also suggests that it is being accumulated there prior to its involvement in sclerotization of the larval cuticle. Larvae were injected with [U-^{14}C]valine and left for 1 h after which their tissues were extracted with a series of solvents. In perchloric acid extracts free ^{14}C-labelled alanine, aspartate, glutamate, glutamine and valine were identified. In methanol-chloroform extracts ^{14}C-labelled phospholipids and neutral fats were present and in the HCl hydrolysate of the protein fraction ^{14}C-valine was the only labelled amino acid detectable. The concentration of RNA and DNA was measured in tissues from 4-d-old larvae and in 1-7-d-old whole larvae. The concentration (μg/mg wet wt. of tissue) of RNA-P in fat body, cutaneous muscle and cuticle was 0.72, 0.30 and 0.14, respectively, and 0.16, 0.006 and 0.011 for DNA-P, giving RNA-P : DNA-P ratios much greater than those found in vertebrate tissues. The concentration of RNA-P was greatest in 2-d-old larvae (1.3 μg/mg) falling to 0.3 μg/mg in 4-d-old larvae. The DNA-P concentration was greatest in 1-d-old larvae (0.12 μg/mg) falling to 0.02 μg/mg in 5-d-old larvae. The base ratios in the RNA from fat body were guanine: adenine 0.67, cytosine: adenine 0.66 and uracil: adenine 1.03 and from cutaneous muscle were 0.74, 0.72 and 0.98, respectively.

95 Price, G.M. THE INCORPORATION IN VITRO OF L-VALINE INTO THE FAT BODY PROTEIN OF THE LARVA OF THE BLOWFLY, Calliphora erythrocephala. Biochem. J. 97, 3 (1965) 33P-34P. Abstr. Presented at the "453rd Meeting of the Biochemical Society, Middlesex Hospital Medical School, England, 8 Oct. 1965".

The incorporation at 25°C of [U-^{14}C]valine into isolated fat bodies of C. erythrocephala was studied. Pre-incubation for ≤ 1 h resulted in a 2- to 3-fold decrease in incorporation rate. The rate of incorporation was maximal in fat body from the youngest larvae examined, i.e. 4-d-olds (20 000 cpm/mg of protein), and then decreased rapidly up to 6-d-old larvae (2000), after which there was a much slower decrease in the rate up to the 8-d-old larvae of white prepupae (500). The rate of [U-^{14}C]valine incorporation over 30 min in the presence of 7-d-old haemolymph was only 50% of that obtained with 4-d-old haemolymph. The specific activity of the protein in precipitated fat body ("retained" protein) and in the supernatant ("released" protein) was estimated separately. The specific activity of the "released" protein increased linearly and at a much greater rate than that of the "retained" protein. After a 2 h incorporation period the specific activity of the "released" protein was 2-3 times that of the "retained" protein.

96 Ramamurty, P.S. ON THE CONTRIBUTION OF THE FOLLICLE EPITHELIUM TO THE DEPOSITION OF YOLK IN THE OOCYTE OF Panorpa communis (MECOPTERA). Expl Cell Res. 33 (1964) 601-5.

Blood proteins are transported into oocytes in order to serve as raw materials for yolk protein. The transport of the protein molecules through the peritoneal sheath, the basement membrane and the follicle epithelium was studied by intra-vital staining with trypan blue and simultaneously by autoradiography. ^{3}H-L-histidine was injected into the body cavity of the scorpionfly, P. communis. An incubation time of 8-15 min limited activity to the areas of protein synthesis.

Uniformly distributed labelling occurred in all stages up to nine, with distinctly weaker labelling in the germinal vesicle (none at all in the yolk spheres). Observations based on greatly increased incubation periods following injection indicated the importation of protein labelled elsewhere in the body with subsequent incorporation into the oocyte with the help of the follicle cells, as from 1 h after injection. The semicolloidal vital dye and the blood proteins are transported into the oocyte by the same mechanism and become incorporated into the yolk spheres. The intravital storage of trypan blue appears to be suitable for demonstrating light microscopically those cells incorporating macromolecules.

97 Ritossa, F.M. EXPERIMENTAL ACTIVATION OF SPECIFIC LOCI IN POLYTENE CHROMOSOMES OF Drosophila. Expl Cell Res. 35, 3 (1964) 601-7.

The Pavia strain of D. buskii was used since its chromosomes are particularly favourable for cytological analysis. New puffing patterns can be induced in Drosophila by several methods known or supposed to depress the level of "high energy phosphate bonds" in the cells. They are temperature shock, anaerobiosis, 2,4-dinitrophenol, salicylate, azide, dicumarol. For autoradiography a mixture of equal concentration of activities of ^{3}H amino acids (DL-lysine 307 mCi/mM; L-tryptophan 1.62 Ci/mM; Dl-leucine 576 mCi/mM) was used for detecting incorporation into proteins. ^{3}H-cytidine (4.9 Ci/mM) and uridine (3.0 Ci/mM) were used for detecting RNA synthesis. The new puffs are points of intense RNA synthesis, and the same puffs are inducible in the salivary glands, midgut, and hindgut (all the larval organs at any time during development, in which a cytological analysis at the puff level can be made in Drosophila).

97-a Ritossa, F.M., Spiegelman, S. LOCALIZATION OF DNA COMPLEMENTARY TO RIBOSOMAL RNA IN THE NUCLEOLUS ORGANIZER REGION OF Drosophila melanogaster. Proc. natn. Acad. Sci. U.S.A. 53, 4 (1965) 737-45.

Experiments were designed to see whether DNA complementary to ribosomal RNA was confined to the nucleolar organizer (NO) region. DNA was prepared from four stocks of D. melanogaster carrying 1,2,3, and 4 doses of the "NO" segment and hybridized to (^{3}H-, ^{32}P-)labelled ribosomal RNA. (^{3}H-labelled RNA was incubated with ♂ DNA. The internal "noise" control was provided by including ^{32}P-ribosomal RNA of Escherichia coli.) The results obtained support the following conclusions. (1) The wild-type genome saturates at 0.27% of the DNA indicating that it contains approximately 200 sites per diploid set for each of the two ribosomal components. (2) The nucleolar organizer regions on the X- and Y-chromosomes contribute equally to the proportion of DNA complementary to ribosomal RNA. (3) The proportions of the DNA found to be complementary to ribosomal RNA in the different stocks correspond to that predicted from the genetic constitution and the assumption that all the DNA complements of ribosomal RNA are confined to the nucleolar organizer locus. (4) By identifying the "NO" segment as the site of the required DNA templates the data support the assertion that the nucleolus is the site of ribosomal RNA synthesis.

98 Rodriguez, J.G., Hampton, R., Chaplin, M. UTILIZATION OF AMINO ACIDS BY THE TWO-SPOTTED MITE, Tetranychus urticae Koch. Bull. ent. Soc. Am. 10, 3 (1964) 166. Abstr.

Glucose-U-^{14}C was utilized to determine nutritionally essential and non-essential amino acids in the mite, T. urticae Koch. The method involved paper chromatography and an amino acid analyser. Amino acids containing large amounts of radioactivity were classified as non-essential and those containing little or no radioactivity as essential.

99 Roth, T.F., Porter, K.R. YOLK PROTEIN UPTAKE IN THE OOCYTE OF THE MOSQUITO Aedes aegypti L. J. Cell Biol. 20, 2 (1964) 313-32.

Yolk proteins are thought to enter certain eggs by a process akin to micropinocytosis but the detailed mechanism has not been previously depicted. In this study the formation of protein yolk was investigated in the mosquito A. aegypti L. Ovaries were fixed in phosphate-buffered OsO_4, for electron microscopy, before and at intervals after a meal of blood. The deposition of protein yolk in the oocyte was correlated with a 15-fold increase in 140 mμ pit-like depressions on the oocyte surface. These pits form by invagination of the oocyte cell membrane. They have a 20 mμ bristle coat on their convex cytoplasmic side. They also show a layer of protein on their concave extracellular side which we propose accumulates by selective adsorption from the extra-oocyte space. The pits, by pinching off from the cell membrane become bristle-coated vesicles which carry the adsorbed protein into the oocyte. These vesicles lose the coat and then fuse to form small crystalline yolk droplets, which subsequently coalesce to form the large proteid yolk bodies of the mature oocyte. In an attempt to determine the pathway by which the proteins, formed after a blood meal, enter the different tissues of the abdomen, mosquitoes were fed on anaesthetized rat made radioactive by an intraperitoneal injection of DL-leucine-^{3}H. Preliminary radio-autographs, and certain morphological features of the fat body, ovary, and midgut, suggest that the midgut is the principal site of yolk protein synthesis in the mosquito.

100 Salpeter, M.M., O'Connor, A. ACETYLCHOLINESTERASE IN MOTOR END-PLATES EVALUATED BY ELECTRON MICROSCOPE AUTORADIOGRAPHY. J. Cell Biol. 27, 2 (1965) 93A. Abstr. 184. Presented at the "5th Annual Meeting of the American Society for Cell Biology, Philadelphia, 10-12 Nov. 1965".

The sites at which acetylcholinesterase (AcChase) occurs within the motor end-plate can be demonstrated by electron microscope autoradiography following the binding of ^{3}H-diisopropylfluorophosphate (DFP) to the enzyme. If the section and emulsion thicknesses are controlled, the distribution of enzyme can be evaluated quantitatively. Small fragment of external ocular and sternomastoid muscles of mouse were fixed with glutaraldehyde. Every DFP-sensitive site present was blocked with unlabelled DFP (10^{-3} M). After washing, the fragments were placed in 10^{-3} M pyridine-2-aldoxime (2-PAM), a specific reactivator of DFP-inhibited AcChase. Subsequent incubation with ^{3}H-DFP (10^{-4} M) introduced radioactive DFP on a 1 : 1 basis only into those sites of AcChase reactivated by the 2-PAM. Non-specific adsorption of ^{3}H-DFP was reduced by a final exchange with unlabelled DFP (10^{-3} M). After postfixation with OsO_4 and embedding in Epon, sections were coated with monolayers of Ilford L4 or Kodak NTE emulsion. End-plates from both muscles showed a highly significant localization of silver grains primarily over the synaptolemma. (From Abstr.)

101 Schaefer, C.H. FREE AMINO ACIDS OF THE VIRGINIA PINE SAWFLY, Neodiprion pratti Dyar: THEIR CHROMATOGRAPHIC DETERMINATION AND BIOSYNTHESIS. J. Insect Physiol. 10, 2 (1964) 363-9.

An aqueous solution of U-^{14}C-glucose was injected into larvae in the 3rd, 4th, and 5th instars and also on prepupae. Fifteen amino acids (lysine, arginine, histidine, serine, glycine, glutamic acid, aspartic acid, glutamine, alanine, proline, valine, tyrosine, leucine, isoleucine, and phenylalanine) and four unknown, ninhydrin-positive compounds were detected in the haemolymph of the larvae. Their occurrence was independent of instar and three host plants indicating a selective accumulation of particular amino amino acids. The metabolic incorporation of ^{14}C into proline, alanine, serine, glycine, and radioactivity were detected in histidine and glutamic acid indicating limited biosynthesis. Altogether seven amino acids and one unknown, ninhydrin-positive substance were synthesized in vivo and are apparently non-essential. The separation and identification of free amino acids with thin-layer chromatography are described; a solvent system for separating leucine and isoleucine is given.

102 Schlossberger-Raecke, I., Karlson, P. ZUM TYROSINSTOFFWECHSEL DER INSEKTEN. XIII. RADIOAUTOGRAPHISCHE LOKALISATION VON TYROSINMETABOLITEN IN DER CUTICULA VON Schistocerca gregaria Forsk. (Tyrosine metabolism of insects. XIII. Autoradiographic localization of tyrosine metabolites in the cuticle of Schistocerca gregaria). J. Insect Physiol. 10, 2 (1964) 261-6. (In German, with English summary)

When tyrosine-U-^{14}C (I) was injected into the abdomens of 4th-instar larvae of S. gregaria, ^{14}C was mainly found in the outer layers of the cuticle after moulting. The amount of ^{14}C was dependent on the degree of sclerotization and on the time interval between the injections and moulting. When I was injected 15-70 h before moulting, the incorporation of ^{14}C into the cuticle was high and there was no difference between the normal and the albino strain of the insect. This suggested that precursors of the sclerotizing substances are formed 15-70 h before moulting, and that the metabolic processes are controlled by the moulting hormone ecdysone. When I was injected 2-10 h prior to moulting, very little ^{14}C was incorporated into the cuticle of the albino mutant while in normally pigmented insects there was selective labelling of the melanin (II) patches. This indicated that the metabolic processes leading to II as the final product occur much later than the production of the sclerotizing agents. DL-Tryptophan-U-^{14}C metabolites were not incorporated into the cuticle, which proved that it does not participate in sclerotization and pigmentation of the cuticle. (CA 61:1964, 2230 d)

103 Sekeris, C. E. ACTION OF ECDYSONE ON RNA AND PROTEIN METABOLISM IN THE BLOWFLY, Calliphora erythrocephala. p. 149-67 of "Mechanisms of Hormone Action. A NATO Advanced Study Institute, Meersburg/Bodensee, 20-26 May 1964". Karlson, P., Ed. New York, Academic Press. 1965.

The biochemistry of sclerotization has been investigated in detail in the hopes of finding a suitable system for studying ecdysone. Various studies undertaken by the author and his colleagues are described. The activities of the main enzymes involved in tyrosine metabolism during larval development, tyrosine transaminase, phenoloxidase, DOPA decarboxylase, and transacetylase were followed. A direct dependence of the decarboxylase activity on the ecdysone titer was demonstrated. Only the epidermis contained decarboxylase activity, and may be considered as a target tissue for ecdysone in which a specific enzyme is being induced. By means of certain inhibitors of protein synthesis (streptomycin, erythromycin, chloromycin, puromycin) it could be shown that enzyme induction is due to a de novo synthesis of protein. A simple reaction of hormone and enzyme molecule could not be blocked so uniformly by such different inhibitors. A critical phase of primary action of ecdysone was determined. The effect of ecdysone on RNA metabolism was studied. An early effect on nuclear RNA could be demonstrated (Fig. 12) but no influence within the first 2 h on cytoplasmic RNA. The time sequence of ecdysone effects is as follows: The hormone penetrates the cell within 15-30 min, reaching a max. concentration after 1 h; stimulation of messenger RNA is seen within 1-2 h, increase in labelling of microsomal RNA after 3-4 h, and lastly increase of decarboxylase activity due to synthesis of enzyme protein begins after 6-8 h. The possible causal relationship between these events is discussed.

104 Sekeris, C. E., Lang, N. INDUCTION OF DOPA-DECARBOXYLASE ACTIVITY BY INSECT MESSENGER RNA IN AN IN VITRO AMINO ACID INCORPORATING SYSTEM FROM RAT LIVER. Life Sci. 3 (1964) 625-32.

The study showed that the messenger RNA induced by ecdysone is a specific one carrying the information for the synthesis of DOPA-decarboxylase. Calliphora erythrocephala Meig. larvae (considered induced at the white prepupal stage, or controls when 7-d-old larvae) were used. The rate of in vitro incorporation of ^{14}C-L-leucine was determined in the amino acid incorporating system; the messenger RNA used clearly increased the rate of protein synthesis but did not lead to enzyme synthesis. Only the addition of messenger RNA from hormone induced animals led to the appearance of enzyme activity. In experiments on DOPA-decarboxylase activity, ^{14}C-DL-DOPA was used. The percent transformation of DOPA into dopamine was taken as a measure of enzyme activity. An in vitro system from rat liver was used while the messenger RNA was taken from an insect; nevertheless, a functional enzyme molecule was produced. A de novo synthesis of an insect- DOPA-decarboxylase is indicated. The ability of the microsomes to respond to messenger RNA from a different phylum is in agreement with the concept of the universality of the code transcription.

105 Sekeris, C. E., Lang, N. ZUR PROTEIN-BIOSYNTHESE BEI INSEKTEN. DER IN VITRO EINBAU VON AMINOSÄUREN IN PROTEIN DURCH FRAKTION AUS EPIDERMISZELLEN DER SCHMEISS-FLIEGE Calliphora erythrocephala. (Biosynthesis of proteins in insects. In vitro incorporation of amino acids in proteins through fractions from the epidermal cells of the bluebottle fly, Calliphora erythrocephala). Hoppe-Seyler's Z. physiol. Chem. 342, 1-3 (1965) 161-65. (In German, with English summary)

Microsomes from the epidermis of C. erythrocephala larva incorporated leucine-^{14}C into protein in a linear fashion. The addition of albumin, however, decreased this effect. Chloromycetin, streptomycin, and erythromycin also inhibited protein synthesis. Epidermal microsomes from white prepupae, which were 2 d older than the other larval specimens and which had a higher number of polysomes in the epidermis, incorporated even more label into protein than did those of the younger larvae. In its general properties the system is similar to corresponding systems in mammals and bacteria.

106 Shyamala, M. B., Bhat, J. V. ESSENTIAL AMINO ACID REQUIREMENTS OF THE SILKWORM, Bombyx mori. Indian J. Biochem. 2, 3 (1965) 201-02.

When glucose-U-^{14}C was fed to silkworms, all the amino acids became labeled except leucine, phenylalanine, histidine, and threonine. These four were considered as essential for the silkworm. (CA 64:1966, 7095 d)

107 Smirnov, V. N., Kullyev, P., Varshavskiĭ, M., Spirin, A. S. PARTICIPATION OF RIBOSOMES IN THE BIOSYNTHESIS OF SILK FIBROIN. Dokl. Akad. Nauk SSSR 156, 5 (1964) 1221-4.

Study of silkworm silk gland tissues after intake of glycine-^{14}C showed that ribosomes take part in the biosynthesis of fibroin polypeptide chains. (CA 61:1964, 7424 a)

108 Srinivasan, N. G., Corrigan, J. J., Meister, A. BIOSYNTHESIS OF D-SERINE IN THE SILK-WORM, Bombyx mori. J. biol. Chem. 240, 2 (1965) 796-800.

The occurrence of D-serine in the silkworm. B. mori was confirmed, and studies on its formation from L-serine-^{14}C and glucose-^{14}C were carried out. When D-serine-^{14}C was injected into feeding larvae or pupae, it disappeared slowly, and evidence was obtained for its conversion to L-serine in pupae. Injection of L-serine-^{14}C into spinning larvae was followed by the appearance of D-serine-^{14}C. Administration of glucose-U-^{14}C and glucose-1-^{14}C gave L-serine-^{14}C and D-serine-^{14}C; with both types of labelled glucose, L-serine became labelled more rapidly than D-serine. Homogenates of spinning larvae and prepuapae, but not of feeding larvae, catalyzed conversion of L-serine to D-serine. The available data indicate that D-serine is formed by the tissues (probably mainly by the fat body) of B. mori at about the time of pupation. (CA 62:1965, 5614 h)

109 Weinmann, H. P. UNTERSUCHUNGEN MIT MARKIERTEN AMINOSÄUREN ZUM PROTEIN-STOFFWECHSEL NORMALER UND LETALER GENOTYPEN VON Drosophila melanogaster. (Investigations with labelled amino acids of the protein metabolism of normal and lethal genotypes of Drosophila melanogaster). Z. vergl. Physiol. 48, 4 (1964) 429-61. (In German, with English summary)

Valine-^{14}C and glutamic acid-^{14}C, both uniformly labelled, giving a specific activity of $\sim$5 mCi/mM, were injected into larvae and adults of wild-type D. melanogaster. The total amount of radioactivity after glutamic acid-^{14}C decreased more quickly than after valine-^{14}C, a difference due to a higher rate of respiratory decomposition of glutamic acid. Incorporation speed of the injected valine-^{14}C into the proteins was assessed by measuring the distribution of radioactivity on one-dimensional chromatograms, and the significance with protein synthesis is discussed. Injected animals were dissected and the distribution of radioactivity among some organs was established. Radioactivity was incorporated into the ovary from injected homogenized larval fat body and partly also from implanted whole pieces of fat body. After injecting hot amino acid into a larva, marking of the ovary could be slowed down by injection of the cold amino acid. The speed of protein synthesis was tested in normal larvae and homozygotes for the factors letal-translucida (ltr) or letal-meander (lme). Both homozygotes showed a clearly diminished speed of incorporation. Simultaneous injection of valine-^{14}C and a hydrolysate of casein does not accelerate incorporation of valine into the proteins of lme-larvae. The slowed synthesis of proteins in the mutants is evidently not a direct consequency of a deficiency of amino acids. Respiration experiments show that both lethal larvae (ltr/litr and lme/lme) decompose valine more slowly that they do glutamic acid. Although the overall respiration rate (mm^3O_2/mg fresh wt.) of the larvae is not diminished, they decompose valine much more slowly than do ltr larvae of normal individuals.

110 Winteringham, F. P. W., Disney, R. W. A RADIOMETRIC STUDY OF CHOLINESTERASE AND ITS INHIBITION. Biochem. J. 91 (1964) 506-14.

A simple radiometric method has been developed for the micro-estimation of acetylcholinesterase activity over a wide range of substrate concentrations (100-0.01 mM). Enzyme and [carboxy-^{14}C] acetylcholine as substrate were incubated for the required time. Enzyme action was halted by the addition of acid and excess of inhibitor to a small sample which was then allowed to dry. Free [^{14}C]acetate was thus completely volatile whereas the ^{14}C-labelled substrate was not. Reference assays in which the enzyme was absent or inactivated were made simultaneously.

The difference in residual ^{14}C activity measured by a suitable counter therefore represents enzymic hydrolysis of the substrate. The method has been used for studying the properties and inhibition of cholinesterase in adult housefly head and mammalian blood preparations. The enzymic activity-substrate concentration relationships of both preparations were in good agreement with those predicted on the basis of Michaelis-Menten theory as modified by Haldane to take into account inhibition by excess of substrate. The effects of sample dilution and changing substrate concentration on the apparent inhibition by an insecticidal carbamate were similar to those predicted on the basis of competitive reversible inhibition. Under certain kinetic conditions these effects are consistent with the carbamate behaving as a poor but competitive substrate, inhibition being due to carbamoylation of the enzyme as suggested by earlier workers. There is evidence that cholinesterase inhibition by insecticidal carbamates may, have been significantly underestimated in earlier studies.

See also:

15 The distribution of sex-linked recessive lethals induced in Drosophila males by tritiated deoxycytidine. (Kaplan, W.D. et al., 1965)
16 The effect of tritiated thymidine and gamma irradiation on the mortality of adult Drosophila melanogaster. (Kent, E., 1965)
17 The effect of tritiated thymidine and gamma irradiation on the mortality of Drosophila melanogaster larvae. (Kent, E., 1964)
18 The effect of tritiated thymidine and gamma irradiation on the mortality of Drosophila melanogaster larvae. (Kent, E., 1964)
37 Données biochimiques et histochimiques sur l'incorporation du sulfate de sodium radioactif, chez Gryllus bimaculatus de Geer (Insecte, Orthoptère). (Martoja, R., 1964)
49 Polysaccharide and glycoprotein formation in the cockroach II. Incorporation of D-glucose-^{14}C into bound carbohydrate. (Lipke, H. et al., 1965)
123 Les "puffs" des chromosomes géants révèlent l'activité de genes que déclenchent une hormone. (Dajoz, R., 1964)
124 Synthetic activities during spermatogenesis in the locust. (Das, N.K. et al., 1965)
136 Meetings. Insect biochemistry. (Levenbook, L., 1965)
139 Cytochemical investigation of silk glands in Antheraea pernyi. (Makarov, P.V., 1965)
142 Protein synthesis in silk glands. VI. RNA metabolism in fifth instar larvae. (Miura, Y., 1965)
151 Fibroin synthesis in posterior silk glands. VI. Metabolic changes in RNA during the fifth instar. (Ogoshi, S., 1965)
154 Glycine-specific transfer ribonucleic acid (t-RNA) on the posterior silk gland of Bombyx mori. (Onodera, K., Komano, T., 1964)
166 On the action of ribonuclease in salivary gland cells of Drosophila. (Ritossa, F.M. et al., 1965)
168 Recent autoradiographic observations on the incorporation of labeled precursors of nucleic acids and proteins in the fatty bodies of Musca domestica. (Russo-Caia, S., 1964)
172 Effect of ecdysone on nucleic of epidermal cells of Calliphora larvae in vitro. (Sekeris, C.E. et al., 1965)
173 The action of ecdysone on nucleic acid metabolism in insects. (Sekeris, C.E. et al., 1965)
174 The mechanism of action of hörmones. V. The effect of ecdysone on RNA metabolism in the epidermis of the blowfly, Calliphora erythrocephala. (Sekeris, C.E. et al., 1965)
176 The ribonucleic acid from the silk gland of the silkworm and the amino acid code. (Szafrański, P, et al., 1964)
179 Synthesis and transfer of DNA, RNA, and protein during vitellogenesis in Rhodnius prolixus (Hemiptera). (Vanderberg, J.P., 1964)
191 Incorporation of N-methylaminoethanol and N-dimethylaminoethanol into the phospholipids of the house fly, Musca domestica. (Bridges, R.G., Ricketts, J., 1965)
226 Studies in D-serine and D-2,3-diaminipropionic acid in Bombyx mori. (Corrigan, J.J., 1965)
235 Carbohydrate-amino acid conversions during cuticle synthesis in Periplaneta americana. (Lipke, H. et al., 1965)
236 Molt and intermolt activities in the epidermal cells of an insect. (Locke, M. et al., 1965)

239 Autoradiographic investigations on the function of the egg follicles and the nurse cells during yolk formation and protein synthesis in the fly ovary. (Bier, K., 1963)
242 Analytical and histological study of the head and thorax glands in the honeybee Apis mellifica. (Hanser, G., Rembold, H., 1965)
233 Neurosecretory control of ovarian development in the desert locust. (Highnam, K.C., 1961)
245 Neurosecretory control of ovarian development in the desert locust. (Highnam, K.C., 1962)
246 Intermediary metabolism and the insect fat body. (Kilby, B.A., 1965)
254 The metabolism of acetylcholine in the intact central nervous system of an insect (Periplaneta americana). (Treherne, J.E., Smith, D.S., 1965)
260 Metabolism of choline in Periplaneta americana. (Kumar, S.S., Hodgson, E., 1964)
265 The endocrine control of adult reproductive diapause in the chrysomelid beetle, Galeruca tanaceti (L.) III. (Siew, Y.C., 1965)
408 The effect of malathion on the catabolism of labelled glucose in Blattella germanica (L.) (Mansingh, A., 1964)

5. Nucleic Acids. Nucleotides

111 Antonov, A.S., Grigor'eva, S.P., Ivanova, P.V., Belozerskiĭ, A.N. NUCLEOTIDE COMPOSITION OF RAPIDLY TAGGED RIBONUCLEIC ACID IN SILK GLAND OF Bombyx mori. Dokl. Akad. Nauk SSSR 154, 1 (1964) 216-9.

Ribonucleic acid (RNA) rapidly acquired the tracer from $Na_2H^{32}PO_4$ fed to the caterpillars of B. mori. This RNA contained the nucleotides in the proportion of (cytidine + guanine)/(adenine + uridine) = 0.65-0.66 in the fibroin and ceresin parts of the gland; this corresponded to the nucleotide proportions in the deoxyribonucleic acid of the gland. Thus, the matrix RNA of the gland had a different nucleotide proportion from that of soluble RNA and ribosomal RNA of this organ. No information about the biochemical paths of synthesis of silk protein could be deduced from this information. (CA 60:1964, 11098b)

112 Arnold, G. AN AUTORADIOGRAPHIC STUDY OF RNA SYNTHESIS IN ISOLATED SALIVARY GLANDS OF Drosophila hydei. I. AUTORADIOGRAPHIC STUDIES. J. Morph. 116, 1 (1965) 65-87.

The dry mass of cellular structures in isolated Drosophila salivary glands was determined by interference microscopy; a correction which compensates for self-absorption of β-particles, and consequent lowered grain counts, is discussed. The correction factors are 12.0 for nucleolus, 5.0 for nucleoplasm and 8.8 for cytoplasm. After 15 s in uridine-^3H, label was localized over the nucleolus; after 1 min, nucleoplasm RNA became labelled also. In situ synthesis of some nucleolar RNA is indicated. Comparisons of uridine-^3H and cytidine-^3H incorporation were made in glands exposed briefly to isotope, followed by transfer to unlabelled nucleoside solutions. The data suggest two RNA fractions in nucleoli. Rapid turnover and higher uridine incorporation characterized one fraction, which resembled RNA of nucleoplasm metabolically. The second nucleolar RNA incorporated less uridine, remained longer in the nucleolus, and resembled cytoplasmic RNA in precursor incorporation pattern. Preincubation in Actinomycin D before uridine-^3H labelling resulted in 80% inhibition of RNA synthesis in both nucleolus and nucleoplasm. Longer isotope exposures produced some increase in labelling. Actinomycin treatment delayed appearance of label in cytoplasmic RNA. After HCl extraction of uridine-^3H-labelled RNA, some activity, presumed to be incorporated in DNA, remained. This non-extractable label appeared earliest over nucleoli, and subsequently over chromatin. Actinomycin treatment abolished incorporation of non-extractable label into nucleoli. (From auth.)

113 Barth, R.H., Jr., Bunyard, P.P., Hamilton, T.H. RNA METABOLISM IN PUPAE OF THE OAK SILKWORM, Antheraea pernyi: THE EFFECTS OF DIAPAUSE, DEVELOPMENT, AND INJURY. Proc. natn. Acad. Sci. USA 52, 6 (1964) 1572-80.

RNA was extracted from the wing hypodermis and the fat body of the silkworm and fractionated by sucrose gradient centrifugation. Relative rates of synthesis of RNA were determined by labelled uridine incorporation. In diapausing pupae there were two peaks of ribosomal RNA (16 and 28S) with a large amount of transfer RNA (4-8S). Uridine incorporation was very slight. Dramatic changes in RNA resulted following injury, with large increases in 28S, 16S, and 12S (probably messenger RNA), and in uridine incorporation, indicating rapid synthesis of RNA. In developing pupae the same changes occurred in RNA metabolism, but less profoundly. Injection of actinomycin prior to the isotope blocked incorporation of uridine into RNA in the injured and developing pupae. (CA 62:1965, 10893b)

114 Beermann, W., Pelling, C. ^{3}H-THYMIDIN-MARKIERUNG EINZELNER CHROMATIDEN IN RIESENCHROMOSOMEN. (The labelling of individual chromatids of giant chromosomes with ^{3}H-thymidine). Chromosoma 16, 1 (1965) 1-21. (In German, with English summary)

^{3}H-thymidine was administered to fertilized eggs of Chironomus tentans at the time of oviposition. Larvae hatching from these eggs were raised to the end of the 4th instar when they were dissected and their salivary glands squashed. Good autoradiographs of the giant chromosomes were obtained after two years' exposure. Three principal patterns of labelling were observed: 1) "single-strand labelling", where one or two chromosome pairs/nucleus show one single helical track of silver grains typically running from one end of the chromosome to the other; 2) "two- or four-strand labelling", where all chromosome pairs of a nucleus show two or four densely labelled tracks; and 3) "diffuse strand labelling" where the level of labelling is generally low and the number of labelled strands per chromosome pair seems to be >8. Approximately half the nuclei remained unlabelled. In 9 out of 70 chromosome pairs with single strand labelling the labelled strand begins at one end of the chromosome but ends interstitially. The labelled single strands must be intact mitotic half-chromatids (or their crossover products) which received their label during DNA synthesis early in embryonic development, probably before blastoderm formation. A model of cell lineage involving selection against labelled nuclei accounts for the observed distribution of labelled single strands. The occurrence of 2- and 4-strand labelling points to a smaller number of mitotic divisions preceding the formation of some portions of the salivary glands. The results are in line with the classical concept of polyteny.(From auth. summary)

115 Berlowitz, L. CORRELATION OF GENETIC ACTIVITY, HETEROCHROMATIZATION, AND RNA METABOLISM. Proc. natn. Acad. Sci. U.S.A. 53, 1 (1965) 68-73.

A comparison of RNA synthesis of heterochromatin and euchromatin in larval tissues of the mealy bug was made by determining uridine-^{3}H uptake in testes and wing-bud tissues. Mealy bug heterochromatin was largely discontinued RNA synthesis. (CA 62:1965, 12212b)

116 Bier, K. GERICHTETER RIBONUKLEINSÄURETRANSPORT DURCH DAS CYTOPLASMA. (Directed RNA transfer through the cytoplasm). Naturwissenschaften 51, 17 (1964) 418. (In German)

The oocyte nucleus does not take part in RNA synthesis in Musca domestica and Calliphora erythrocephala. Results obtained with double injections of tritiated RNA-precursors at 20-30 min intervals and an incubation period of 40-60 min indicated a directed RNA transfer from the nurse cells to the oocyte. RNA synthesized in the polyploid nuclei of nurse cells reaches the oocyte via intercellular cytoplasmic bridges, the fusomes. ^{3}H-labelled uridine and cytidine were used.

117 Bier, K. ÜBER DEN TRANSPORT ZELLEIGENER MAKROMOLEKÜLE DURCH DIE KERNMEMBRAN. I. RNS-SYNTHESE AND RNS-TRANSPORT UNTER SAUERSTOFFMANGEL UND BEI HERABGESETZTER TEMPERATUR. (Study on the transport of macromolecules of the cell across the nuclear membrane. I. RNA synthesis and transfer under conditions of oxygen deficiency or reduced temperature). Chromosoma 16, 1 (1965) 58-69. (In German, with English summary)

The effect of O_2-deprivation and temperature reduction on the incorporation of RNA precursors, ^{3}H-uridine and ^{3}H-cytidine, was investigated in various larval tissues and in adult ovaries of Musca domestica L. Whereas RNA synthesis in most tissues was markedly reduced under anaerobic conditions, moderate synthesis continued in muscle cell and nurse cell nuclei. RNA macromolecules (mRNA and rRNA), however, do not migrate into the cytoplasm. RNA synthesis within the cell nucleus was affected to a lesser degree by a sudden reduction temperature than the passage of RNA through the nuclear membrane, which dropped to a very low level. Macromolecular RNA does not, therefore, diffuse into the cytoplasm but is transported actively through the nuclear membrane. The malformations caused by anaerobiosis during embryogenesis are linked with active RNA transfer through the nuclear membrane and a disruption in the transfer and synthesis sequence.

118 Bier, K. DIE KERN-PLASMA-RELATION UND DAS RIESENWACHSTUM DER EIZELLEN. (The nucleus-plasma relationship and its bearings on the giant growth of the egg cell). Zool. Anz., Suppl. 27 (1964) 84-91. (In German)

Oocyte nuclei which are in meiotic prophase remain tetraploid up to the end of the growth period. The volumes of such egg cells exceed those of cells in a similar nuclear phase by a factor of 10 000 or 100 000. To a considerable extent, this increase is due to an increase in protein content, partly in the ooplasm, partly as yolk proteins. Protein synthesis takes place only in the presence of RNA. Oocyte nuclei should therefore be foci of extreme RNA synthesis. This did not, however, prove to be the case. Polytrophic ovaries (Panorpa communis) showed only very slight RNA synthesis with ^{3}H-uridine, and this absence of synthesis was even more pronounced in Calliphora erythrocephala, Musca domestica and Drosophila. The same was shown by the author to be true of the telotrophic type of ovary (Oncopeltus fasciatus (Dallas)). During its growth period the oocyte nucleus therefore synthesizes insufficient or no RNA. The oocyte grows very slowly initially, and the proteins are used up even more slowly. The oocyte synthesizes some protein from RNA synthesized by other cell nuclei, and the oocyte grows by taking up protein molecules from other cells. The tremendous increase in volume cannot be explained on the basis of the RNA metabolism of the oocyte.

119 Birnstiel, M.L., Sirlin, J.L., Jacob, J. NUCLEOLUS: A SITE OF TRANSFER RIBONUCLEIC ACID SYNTHESIS. Biochem.J. 94, 1 (1965) 10P-11P.

Nucleolar RNA from the salivary glands of Smittia was labelled with uridine-^{14}C in the presence of 5.6-dichloro-1-(β-D-ribofuranosyl)benzimidazole (I) and the 4, 5, 6-trichloro derivative (II). If the glands were incubated in the absence of the I and II, both the nucleolus and chromosomes were heavily labelled and the cytoplasm only slightly labelled. The labelled RNA was heterogeneous, including fractions >28S and fractions between 8S and 28S. Inclusion of I and II (which inhibit chromosomal and cytoplasmic RNA synthesis) gave a small amount of labelled 28S RNA and a high concentration of labelled RNA with the sedimentation characteristics of transfer RNA. Transmethylation in the presence of methionine-methyl-^{14}C and puromycin as the inhibitor of protein synthesis showed that incorporation into the cytoplasm was 4-fold that of the nucleolus. The cytoplasmic label was unaffected by RNase, while 87% of the nucleolar activity could be removed by the enzyme. Transmethylation was confined to 4S RNA. Transfer RNA was apparently a product of nucleolar RNA synthesis. (CA 62:1965, 16546d)

120 Bowers, B., Williams, C.M. PHYSIOLOGY OF INSECT DIAPAUSE. XIII. DNA (DEOXYRIBONULEIC ACID) SYNTHESIS DURING THE METAMORPHOSIS OF THE CECROPIA SILKWORM. Biol. Bull. 126, 2 (1964) 205-19.

DNA synthesis at stages in the life-cycle of the cecropia (Hyalophora cecropia) and Samia cynthia was examined by radioautographic survey of the incorporation of ^{3}H-thymidine. In sections of pupae previously injected with ^{3}H-thymidine, incorporation of the nucleotide into DNA, as well as cell division, was observed in several tissues as late as one week after pupation. In diapausing pupae, incorporation of tymidine occurred in spermatogonia, haemocytes, a few midgut regenerative cells, and a few cells of the testicular walls. Neither incorporation nor mitotic figures were observed in diapausing epidermal tissues. Large epidermal injury increased DNA synthesis in the blood cells of diapausing pupae and induced incorporation in a few epidermal cells in the immediate vicinity of the wound. Epidermal cells outside the wound periphery did not incorporate thymidine after injury. A generalized incorporation of thymidine was observed in synchrony with the termination of pupal diapause. The first cells to show increased incorporation were the regenerative cells of the midgut, followed by cells of the epidermis, muscles, nerves, tracheoblasts, and, ultimately, the fat body. The incorporation in the epidermis precedes and then accompanies the extensive cell division associated with adult differentiation. Lack of DNA synthesis in the epidermal tissues of injured diapausing pupae appears to be the first biochemical or metabolic criterion so far recognized that permits one to distinguish between an injured pupa and a developing adult. (CA 61:1964, 6101h)

121 Cannon, G.B. PUFF DEVELOPMENT AND DNA SYNTHESIS IN Sciara SALIVARY GLAND CHROMOSOMES IN TISSUE CULTURE. J. cell. comp. Physiol. 65, 2 (1965) 163-81.

The salivary glands of S. coprophila were cultured for 24 h in a chemically defined medium. Chromosome development with puff formation and condensation occurred. DNA synthesis proceeded in normal fashion in six different stages in the 4th larval instar as shown by incorporation of ^{3}H-thymidine.

122 Clever, U. PUFFING CHANGES IN INCUBATED AND IN ECDYSONE TREATED Chironomus tentans SALIVARY GLANDS. Chromosoma 17, 4 (1965) 309-22.

Incubation of salivary glands of last instar C.tentans in a variety of media led to more or less drastic changes in puffing patterns. Degree and pattern of these changes varied with concentration and composition of the media. In most of the media tested ecdysone had the same effects as in vivo, i.e. it induced puffs I-18-C and IV-2-B. Among the media tested was a 0.6% NaCl solution which did not contain any K ions. An addition of K ions did not influence the result. After incubations for longer periods (>20 h) the chromosomes lost their ability to respond to ecdysone though they still incorporated ^{3}H-uridine in a normal fashion. Ecdysone does not appear to influence puffing via a change in intracellular K$^+$/Na$^+$ ratio.

123 Dajoz, R. LES "PUFFS" DES CHROMOSOMES GEANTS REVELENT L'ACTIVITE DE GENES QUE DECLENCHENT UNE HORMONE. Nature, Paris 3350 (1964) 218-25.

Revue. Une interprétation biochimique, génétique, et endocrinologique est proposée, basée sur les données obtenues surtout sur les insectes. L'auteur considère le rapport entre les "puffs" des chromosomes géants avec l'action de l'enzyme ecdysone. On cite dans le texte des travaux utilisant des radioisotopes sans pourtant fournissant des références entières.

124 Das, N.K., Siegel, E.P., Alfert, M. SYNTHETIC ACTIVITIES DURING SPERMATOGENESIS IN THE LOCUST. J. Cell Biol. 25, 2(1965) 387-95.

In isolated testes of the locust Schistocerca gregaria, DNA synthesis is completed prior to initiation of meiosis. Protein synthesis continues throughout the whole meiotic cycle as well as during spermatid development. All spermatocytes, except those in 1st or 2nd metaphase, anaphase, and early telophase are labelled after exposure to uridine-^{3}H (I) for 3-30 min or to cytidine-^{3}H (II) for 1-2 h. Nucleolar labelling is detected only after exposure of the emulsion for a relatively longer time. In tubules exposed to I or II for 3-120 min, early spermatid nuclei are found to be labelled. The condensing and elongating spermatids are inactive with respect to uptake of RNA precursors. Depression of RNA synthesis, however, is not always accompanied by cytologically detectable condensation of chromatin, since very little or no RNA is synthesized in spermatids in which chromatin condensation has barely begun. Protein synthesis decreases slightly in metaphase, anaphase, and early telophase. In the absence of new RNA synthesis, protein synthesis continues at a reduced rate, as the developments of spermatids progress. Almost all of the RNA synthesized in meiotic nuclei, in contrast to mitotic nuclei, generally is of chromosomal origin. (CA 63:1965, 6060 gh)

125(2) Gay, H. Carnegie Inst. Washington Yr Book 62 (1963) 503-11.

Puffing phenomena in giant chromosomes of dipteran salivary glands are discussed and pulse labelling.

126 Gay, H. NEW EVIDENCE ON CHROMOSOME STRUCTURE AND FUNCTION. Science, N.Y. 146 (1964) 425.

"Pulse-labelling" revealed integrated functional responses of numerous "paired" chromonematic strands in salivary-gland chromosomes of Drosophila melanogaster. Incorporation of ^{3}H-thymidine was initiated at some of the many sites along the chromosomes but was similar in the two homologues. In hybrids of D. melanogaster and D. simulans occasional differences in pattern of incorporation are detectable in "homologues", which reveal functional as well as structural differences at the chromosomal level. With respect to RNA synthesis, a 30-s pulse with ^{3}H-uridine produced labelling throughout the length of the chromosomes, as if all gene loci were actively engaged in synthesis.

127 Grell, R.F., Chandley, A.C. EVIDENCE BEARING ON THE COINCIDENCE OF EXCHANGE AND DNA REPLICATION IN THE OOCYTE OF Drosophila melanogaster. Proc. natn. Acad. Sci. U.S.A. 53, 6 (1965) 1340-46.

Incorporation of thymidine-^{3}H was used as a cytological marker for the replication time of DNA, and increase in crossing-over induced by elevated temperature as a genetic marker in D.melanogaster oocytes. The interval between the occurrence of the two processes and the mature oocyte averaged 8-9 d. Both events occurred roughly at the same time, in the early 16-cell cysts located mainly in the middle germarium, and perhaps in the final firemeiotic interphase stage. (CA 63:1965, 8788g)

128 Grell, R.F., Chandley, A.C. CORRESPONDENCE BETWEEN THE TIMES OF DNA REPLICATION AND CROSSING-OVER IN THE OOCYTE OF Drosophila melanogaster. p.62 of "Biology Division Semiannual Progress Report for the Period Ending February 15, 1965". ORNL-3768, Oak Ridge National Lab., Tenn. May 1965, 205p.

When ^{3}H-thymidine is injected into females, it is incorporated into the DNA of the oocyte at the time of the last replication and remains undiluted by further replication. The results indicate that DNA replication and crossing-over are roughly coincident and suggest that both processes occur in the early 16-cell cyst in a stage which may correspond to the last premeiotic interphase.

129 Henderson, S.A. RNA SYNTHESIS DURING MALE MEIOSIS AND SPERMIOGENESIS. Chromosoma 15, 4 (1964) 345-66.

Using ^{3}H-uridine, the course of RNA synthesis has been followed autoradiographically during all stages of male meiosis and spermiogenesis in the locusts Schistocerca gregaria and Cyrtacanthacris tartarica and the grasshopper Chorthippus brunneus. Using ^{3}H-thymidine, premeiotic DNA synthesis was followed in C.tartarica. RNA synthesis is actively carried out by all autosomes throughout first meiotic prophase, up to and including diakinesis, and at second prophase. No RNA synthesis occurs at the contracted stages of first or second metaphase or first or second anaphase. RNA is again synthesized by young spermatids, but such synthesis ceases by the time that differentiation begins. No label was detected in the nuclei of differentiating spermatids, even after 8 h incubation with ^{3}H-uridine. Morphological and functional comparisons suggest that orthopteran prophase chromosomes at male meiosis, and proably all prophase chromosomes, are lampbrush in nature, though to varying degrees. The X univalent, allocyclic in its appearance and staining properties, is apparently completely inactive throughout the whole of meiosis. No RNA or DNA precursor could be successfully demonstrated to be incorporated by the X at any stage of male meiosis. Nucleoli are present at interphase and early prophase but are usually absent during later prophase stages in this material. They do not label heavily in advance of, or at the same time as, the commencement of the labelling of the rest of the chromatin; they only accumulate greater densities of label after several hours' incubation with the labelled precursor. No independent cytoplasmic synthesis of RNA could be detected after up to 2 h in vitro incubation in labelled saline at 30°C, though nuclei are heavily labelled after only $\frac{1}{2}$ h. It is some 2-4 h before nuclear synthesized RNA appears to pass to the cytoplasm in detectable amounts. (Auth. summary)

II/320 Hosoda, J., Shigematsu, H., Mizuno, S., Takahashi, H., Maruo, B. RIBONUCLEIC ACID METABOLISM IN THE POSTERIOR SILKGLAND OF SILKWORM, Bombyx mori, DURING THE FIFTH INSTAR. Biochim. biophys. Acta 72 (1963) 544-54*

RNA metabolism in the posterior silkgland of the silkworm, B.mori L.during the 5th instar has been studied. The base composition of the bulk RNA did not change significantly during the instar. ^{32}P-pulse labelling during the earlier stage of the instar indicated the synthesis of a rapidly turning-over RNA having a base composition different from that of ribosomal RNA and resembling that of DNA. Sedimentation analysis of RNA at this stage revealed the presence of components having different sedimentation constants from those of the ribosomal and s-RNA. At a later stage of the instar, there was no evidence for the occurrence of a rapidly turning-over RNA having a base composition different from that of ribosomal RNA. The role of RNA in silk fibroin synthesis is discussed. (Auth.)

130 Jacob, J., Sirlin, J.L. SYNTHESIS OF RNA (RIBONUCLEIC ACID) IN VITRO STIMULATED IN DIPTERAN SALIVARY GLANDS BY 1, 1, 3-TRICYANO-2-AMINO-1-PROPENE. Science, N.Y. 144 (1964) 1011-12.

The uptake of ^{3}H-uridine (and to somewhat lesser extent guanosine) by cells from larval salivary glands of Smittia parthenogenetica was considerably enhanced in the presence of 1, 1, 3-tricyano-2-amino-1-propene and this uptake was not suppressed by Actinomycin D or dichlororibofuranosylbenzimidazole, substances which suppress RNA and deoxyribonuleic acids, respectively. The enhanced uptake appeared in RNA in the nucleolus. (CA 61:1964, 3461b)

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* Cited by title (Previews) only in Vol.II.

131 Kullyev, P. CONTENT OF NUCLEIC ACIDS IN SILK GLANDS OF SILKWORM VARIETIES DIFFERING BY THEIR PRODUCTIVITY. Izv. Akad. Nauk turkmen. SSR, Ser. Biol. 1 (1965) 70-74. (In Russian)

The relation was followed between the silk gland size, its nucleic acid content, and silk productivity in three silkworm (Bombyx mori) varieties. During the last larval instar the silk gland weight increased 5-17-fold without changes in the cell number. The concentration of DNA decreased, but its amount per cell increased. Labelled thymidine incorporated intensively into DNA of the silk glands. The glands contained a high concentration of RNA and its amount per cell increased during the last instar. A linear dependence was found between the amount of RNA per cell and silk productivity. (CA 63;1965, 2160f)

132 Kullyev, P., Zbarskiĭ, I.B., Ramenskaya, G.P., Samarina, O.P. RNA (RIBONUCLEIC ACID) BIOSYNTHESIS IN THE SILK GLAND OF THE SILKWORM. Biokhimiya 29, 3 (1964) 470-76. (In Russian). English Translation: Biochemistry 29, 3 (1964) 407-12.

Intensive synthesis of RNA takes place only in the 1st half of the 5th instar and is accomplished substantially before the beginning of the synthesis of active fibroin. RNA remains comparatively stable in the period of active fibroin synthesis; slight incorporation of adenine is evidently not related to the synthesis of new molecules on the RNA template and can be explained better by the exchange of end nucleotides of soluble RNA and a non-specific radioactivity background. Investigation of adenine-^{14}C incorporation by radiography showed that primary incorporation in the period of RNA synthesis takes place in nucleus structures, where evidently the RNA synthesis is localized. Fractionation of the gland by heat processing with phenol yielded fractions with higher metabolic activities. Contrary to mammalian tissues, specific activity of these fractions kept increasing for a long time. ^{32}P in the form of $Na_2H^{32}PO_4$ and adenine-8-^{14}C, with specific activity 5 mCi/mg, were introduced into silkworms in vivo, or were incubated with gland in vitro. Adenine-8-^{14}C in doses from 0.3 to 3 mCi/g was used in the autoradiographic part of the work. (Ca 61:1964, 6095a)

133 Lara, F.J.S., Lopes, C.R., Foresti, L. SEDIMENTATION CHARACTERISTICS OF RAPIDLY LABELED RNA FROM THE SALIVARY GLAND CELLS OF Rhynchosciara angelae. Life Sci. 4, 5 (1965) 579-82.

Sedimentation studies of RNA from salivary glands of R. angelae larvae show four distinct absorption peaks corresponding to particles with sedimentation constants of 45S, 28S, 16S, and 4S. The incorporation of uridine-^{3}H into RNA in vivo was greatest in the heavier fractions; this incorporation was inhibited by pretreatment with actinomycin D. (CA 63:1965, 2034c)

134 Leach, W.M. SOME FACTORS INFLUENCING THE UTILIZATION OF TRITIATED THYMIDINE IN GRASSHOPPER EMBRYOS. Diss. Abstr. 26 (1965) 1232.

The following were examined in neuroblasts of the grasshopper Chortophaga viridifasciata (De Geer) (1) the thymidine "pool" during mitosis, (2) the effects of excess unlabelled thymidine and of 5-fluorodeoxyuridine (FUdR) on the "pool" and (3) the effects of unlabelled thymidine and FUdR on mitosis. For exposure of neuroblasts, dissected embryos were placed in culture medium containing ^{3}H-thymidine (^{3}HTdR), ^{3}H-uridine (^{3}HU), unlabelled thymidine, FUdR, or combinations of these compounds. Neuroblasts were examined in hanging drop cultures with bright field microscopy. Uptake of radioactivity was assayed either with autoradiograms or with a windowless Geiger tube gas flow counter. Retention of ^{3}HTdR and its derivatives, other than DNA, was less in neuroblasts exposed during prometaphase and metaphase than during prophase or early telophase. No dilution of intracellularly retained ^{3}HTdR was produced by exposure to excess unlabelled thymidine with the experimental conditions employed. Conversion of ^{3}HU derivatives to precursors utilized in the synthesis of an RNase resistant material is reduced by the presence of FUdR. The reduction of cold acid soluble ^{3}HTdR in the presence of FUdR may be ascribed to the proportionally greater intracellular availability of ^{3}HTdR than of the thymidine derivatives synthesized in vivo. Incorporation of ^{3}HTdR into DNA, however, is nearly negligible in the presence of FUdR. Both excess thymidine and FUdR affect the neuroblast cell cycle during DNA synthesis. Incorporation of ^{3}HTdR into DNA is negligible in neuroblasts blocked in middle telophase. The mitotic ratio of neuroblasts exposed continuously to FUdR is reduced by about 4 h of exposure. Continuous exposure to FUdR either blocks or retards neuroblasts in a stage which appears to be interphase. Posttreatment with thymidine does not restore the normal mitotic rate. Nucleoli in neuroblasts exposed to either excess thymidine or FUdR remain prominent and refractile for long periods of time. In FUdR-treated neuroblasts nucleoli persist into midmitosis.

135 Leach, W.M. RETENTION OF TRITIATED THYMIDINE IN GRASSHOPPER NEUROBLASTS. Expl Cell Res. 35, 1 (1964) 201-4.

In order to determine whether ^{3}H-thymidine is retained in the neuroblasts during a period of no DNA synthesis embryos (~ 13-to 14-d-old) of Chortophaga viridifasciata (De Geer) were incubated at 26°C in culture medium containing ^{3}H-thymidine at 1-10 μCi/ml. It was found that ^{3}H-thymidine which enters cells during a period of no DNA synthesis may be incorporated into DNA during a subsequent period of DNA synthesis. Solutions containing excess unlabelled thymidine proved ineffective in removing all incorporated ^{3}H-thymidine derivatives from neuroblasts.

136 Levenbook, L. MEETINGS. INSECT BIOCHEMISTRY. Science, N.Y. 150 (1965) 643-4.

The symposium on "Insect Biochemistry, Chiba, Japan, 20 Jun.-3 Jul. 1965" was reviewed by Levenbook who also presented a paper. The following comments are taken from his report, and refer to papers relevant to this bibliography.

(a) Miura, Y. discussed the incorporation of ^{14}C-orotate into silk gland cellular particulates. The pattern of labelling depended upon the age of the 5th stage larvae, nuclear RNA being most radioactive at earlier periods. In more mature larvae three types of labelled RNA-low-molecular-weight, ribosomal, and DNA-like-were obtained from large (14 000 g) subcellular particles. The DNA-like RNA, which was isolated in fibrous form, had a low turnover of ^{14}C-orotate.

(b) Shigematsu, H. also considered a DNA-like RNA synthesized by the silk gland in the early 5th instar. However, in his experiments with ^{32}P neither this nor any other RNA fraction had the properties of true messenger RNA. Employing fibroin antibody as a specific test for fibroin, Shigematsu found fibroin synthesized in vitro to be predominantly in the microsomal and soluble fractions. He also reported that blood concentrations of glycine and tyrosine, but not serine or alanine, could regulate the rate of fibroin formation in vivo.

(c) Levenbook, L. described the profiles of individual free amino acids throughout metamorphosis of the blowfly Phormia regina. The analytical picture was supplemented by kinetic data on the rates of oxidation, turnover, and incorporation into protein of labelled alanine and lysine during metamorphosis. The turnover and oxidation of alanine were much more rapid than those of lysine, but the two amino acids were incorporated into protein at about the same rate during metamorphosis.

(d) Corrigan, J.J. considered the occurrence of free D-amino acids in various insects. Young larvae of Bombyx mori contain little or no D-serine. However, at the time of spinning or in the pupa, D-serine, which occurs in most Lepidoptera, accounts for 15-70% of the total. The derivation of the blood D-enantiomorph from D(−)-2,3-diamino propionic acid (DAPA), isolated from silkworm digestive fluid by S. Wada and T. Toyota, was considered a most likely possibility. Preliminary experiments suggested that DAPA itself might be formed from glucose.

(e) Hirano, C. and Tojo, S. presented some recent studies on the distribution and metabolism of an insect purine. In the diapausing rice stem borer (Chilo suppressalis), urate, located primarily in the fat body, was synthesized very slowly; the rate increased markedly in the postdiapause period of development as measured by the degree of incorporation of ^{14}C-glycine into uric acid. In both C. suppressalis and B. mori labelled guanine and alanine were converted to uric acid, and a marked transport of the purine into the developing pupal ovary of B. mori was observed.

(f) Clayton, R.B., working in the field of insect steroids employed the roach Eurycotis floridana as the experimental subject. The roach was raised aseptically on a doubly labelled diet (^{3}H-cholestanol and ^{14}C-cholesterol); analyses for labelled cholesterol, cholestanol, and Δ^{7}-cholestanol revealed three types of functional spaces of different structural specificity among the insect tissues. Together with studies on sterol distribution in subcellular fraction of individual tissues, the data supported the idea of a tissue-specific recurring, repeating structural unit common to all subcellular membranes.

(g) Ikekawa, N. and Saito-Suzuki, M. applied modern analytical techniques to the silkworm. Throughout development the major steroid component is cholesterol, followed by β-sitosterol and campesterol. Larvae were much more active than pupae in converting ^{3}H-β-sitosterol to cholesterol, while esterification of injected ^{14}C-cholesterol was considerably depressed in brainless "dauer" pupae as compared with normal pupae.

(h) Chefurka, W. discussed the difficulties and pitfalls in evaluating the relative importance of the pentose shunt and glycolytic pathways of glucose catabolism in insects. The extent to which glucose was catabolized by these alternative routes was influenced by numerous variables, for example, site of injection of labelled glucose, sex, species, stage of development, and O_2 tension.

137 Lu, C.-H., Ku, C.-J., Wang, P.-Y., Chu, Y.-S. METABOLISM OF RIBONUCLEIC ACID (RNA) IN THE SILK GLAND OF *Samia ricini*. *K'o Hsueh T'ung Pao* (Scientia) 4 (1964) 340-2. (In Chinese)

^{32}P (5 μCi) was injected into the back of the 5th-stage silkworm. Silk glands were isolated at 0.5, 1, and 2 h after injection, macerated, and centrifuged; the supernatant was then extracted with 90% aqueous PhOH to give phenol-soluble RNA (I). In the aqueous phase, RNA soluble in Et_2O+2M NaCl was called low-mol.wt. RNA (II), and the precipitate was high-mol.wt. RNA (III). Radioactivity in RNA was highest in II, lowest in I. Total RNA-P (mg/gland) from the 1st- to 6th-d was: 39.02, 162.00, 400.64, 711.00, 378.84, and 271.74. The percent of I increased, III decreased, and II stayed constant during the 3rd-to 6th-d. Base composition in RNA as determined by electrophoresis and paper chromatography showed both II and III to be standard G-C types, with (guanine + cytosine)/(adenine + uracil) ratio 1.51 and 1.31, respectively. But I has a base ratio of 1.08, and that of silk gland is 0.64. The activity of RNA was determined by radioactivity measurement after incubating glands in Robinson medium containing glycine-^{14}C at 30° for 60 min and interrupting the reaction with 0.7N $HClO_4$. I had a distinct effect in protein formation, II was slightly active, and III was inactive. I and II together were more active than each alone, and the combination of all three was more effective than I and II. The sensitivity of gland to ribonuclease was variable, but less sensitive in later developing stages. The presence of I in silk-protein formation is essential. I is probably the RNA in the chromosome. (CA 61;1964, 13666b)

138 Lu, C.-H., Ku, C.-J., Wang, P.-Y., Chu, Y.-S. RIBONUCLEIC ACID IN THE SILK GLAND OF SILKWORM (*Attacus ricini*). *Shih Yen Sheng Wu Hsueh Pao* (Acta Biol. exp.sin.) 9, 3 (1964) 300-10. (In Chinese)

A. ricini at 5th instar were employed. $Na_2H^{32}PO_4$ was introduced into the body cavity. Various types of RNA of the posterior silk gland were isolated with phenol and Na dodecyl sulphate, and their specific radioactivities were measured. The nucleotide compositions of RNA and DNA were analysed by paper electrophoresis and column chromatography. When the effect of RNA was studied, RNA was added to Robinson's buffered medium in which the silk glands were incubated in the presence of glycine-^{14}C and the incorporation rate into silk protein was compared with that in the absence of added RNA. There were found three types of RNA in the posterior silk glands: high-mol.wt. RNA (H-RNA), low-mol.wt. RNA (L-RNA), and phenol not-liberated RNA (P-RNA). The relative amount of each varied with growth of the silk gland. At the first few days of 5th instar H-RNA was the most abundant but decreased abruptly after 4th day. L-RNA changed slightly in percentage, while P-RNA was the least in amount at beginning, then increased with growth of the worm and finally almost dominated at the later stage, when fibroin synthesis became the most active. When ^{32}P was injected, it incorporated into RNA with highest efficiency at 4th day of 5th instar. P-RNA appeared the most metabolically active. After 4th day of the 5th instar, total RNA in the silk gland was rapidly decreased and the incorporation of ^{32}P was also reduced. L-RNA and H-RNA are typically guanine-cytosine type, with a (guanine + cytosine)/(adenine + uridine) ratio of 1.51 and 1.81, respectively. However, P-RNA has a different composition which tends to approach that of DNA with decreased guanine and cytosine, and increased adenine and uridine. P-RNA but not H-RNA stimulated fibroin synthesis. Combination of 3 RNAs exerted the highest promoting effect. Incorporation of glycine was reduced to less than 40% of the control after treatment of the silk glands of 4th day with RNase, but with similar treatment of the silk glands of 6th day, the inhibition was only a little more than 10%. The effect of RNase became weaker when P-RNA in the silk gland was higher. Inhibition of fibroin synthesis could be partly reversed by addition of P-RNA or mixture of 3 RNAs. P-RNA may contain some parts of messenger RNA. (CA 62;1965, 6847d)

139 Makarov, P.V. CYTOCHEMICAL INVESTIGATION OF SILK GLANDS IN *Antheraea pernyi*. *Tsitologiya* 7, 5 (1965) 616-21. (In Russian)

The silk gland of *A. pernyi* was studied for the content of nucleic acids, acid and basic proteins, and polysaccharides. Autography was carried out after introduction of thymidine-^{3}H, adenine-^{14}C, glycine-^{14}C, and methionine-^{14}C. The nuclei of silk gland cells were rich in DNA and acid proteins, deficient in histones. The amount of acid proteins increased in the last period of the caterpillar life. Migration of DNA into the cytoplasm was observed only in the presence of the jaundice virus in the cell. The volume of the cells of the silk gland increased at the peak of the synthesis of fibroin. The amount of RNA in the nuclei increased up to the beginning of the cocoon stage. The cytoplasm was rich in acid proteins and also contained basic proteins, acid mucopolysaccharides, and glycogen. The fibroin contained methionine (contrary to the mulberry silkworm, in whose fibroin no methionine or cystine is found). The silk of *A. pernyi* contained almost no diamino acids (1%), but was rich in tyrosine, tryptophan, histidine, and SH groups (the mulberry silkworm fibroin does not contain any S-containing amino acids). The synthesis of fibroin from its precursor at the peak of silk secretion was very rapid. The ^{14}C from glycine-^{14}C was detected 30 min after its introduction, not only in the gland cells, but also in the silk (the corresponding time in the mulberry silkworm was 2 h). (CA 64; 1966, 2466f)

140 Mead, C.G. A DEOXYRIBONUCLEIC ACID-ASSOCIATED RIBONUCLEIC ACID FROM *Drosophila melanogaster*. *J. biol. Chem.* 239, 2 (1964) 550-4.

A deoxyribonucleic acid-associated ribonucleic acid has been isolated from *D. melanogaster*. Several of the properties of this RNA are consistent with those postulated for an RNA serving as an intermediate in the transfer of genetic information. The ratio of DNA to RNA in the complex was 2:1 on a molar nucleotide basis. The molar nucleotide composition of the RNA was similar to that of the DNA (equating uridine with thymidine) and distinct from that of the microsomal RNA or soluble RNA. Treatment with ribonuclease, deoxyribonuclease, or heat altered the sedimentation properties of the DNA-RNA complex. The T_m of the DNA, however, was only slightly increased (2°) after removal of the RNA with ribonuclease. The RNA associated with the DNA of 3rd instar larvae was found to be metabolically active as measured by ^{32}P incorporation. When the resulting progeny were to be uniformly labelled with ^{32}P, the phosphoric acid was omitted from the medium and 5-10 μCi of ^{32}P-orthophosphate were added per ml of medium. Two types of RNA, both of which were associated with the DNA of larvae, were distinguished by their relative metabolic stabilities.

141 Michaels, G., Blumberg, B. STUDY ON RNA FROM 80S RIBOSOMES FROM *Drosophila virilis* LARVAE. *J. Cell Biol.* 27, 2 (1965) 65A. Abstr. 127. Presented at the "5th Annual Meeting of the American Society for Cell Biology, Philadelphia, 10-12 Nov.1965".

Ribosomes with $s_{20,w}$ of 80S have been isolated from 3rd instar larvae of *D. virilis* both by differential centrifugation and by sucrose density gradient separation (SDG); the RNA (rRNA) was extracted by adjusting to 1% sodium dodecyl sulphate, phenol treatment, and ethanol precipitation. The sedimentation profile of the rRNA has been characterized by 15-30% SDG analysis recorded on a Gilford model 2000 automatic recording spectrophotometer, and showed two peaks as expected, the heavier one occurring in larger yields. Determination of the sedimentation coefficient, however, gave unexpected results in terms of the usual ~28S and ~18S obtained as values for the rRNA of other 80S particles. The values have been calculated by simultaneously running ^{32}P-labelled *Escherichia coli* rRNA and determining the relative placement of the O.D. and the cpm curves. Sedimentation coefficients calculated by this method, assuming the *E. coli* peaks were 23S and 16S, were 19.5S and 12.5S. The larval findings were corroborated by concurrent runs using rRNA from *P. paladium* and *E. coli*; the calculated values were 20.5S and 12S. Base analyses were performed using Dowex-50 resin after the method of Katz and Comb (J. Biol.Chem.238;1963, 3065), determining the yield spectrophotometrically. 'Reproducible results on the total RNA from isolated 80S gave 26.6 ± 0.5% U; 23.7 ± 2% G; 25.7 ± 0.5% A; and 20.9 ± 1.4% C. Analysis of the separated peaks has been performed and showed distinct differences in base composition. Comparing the values of the total rRNA with those reported for a variety of other 80S rRNA's (Petermann, The Physical and Chemical Properties of the Ribosomes, 1964, p.106) indicated that the *D. virilis* had considerably higher A and U and lower G and C. The values were similar, however, to those reported by Mead for *D. melanogaster* microsomal RNA (J.Biol.Chem.239:1963, 550). In comparison with the rRNA of 80S RNP particles of other plants and animals, differences have been found here both in the sedimentation coefficient and in the base composition, although the sedimentation coefficients of the parent particles are similar. (From abstr.)

142 Miura, Y., Ito, H., Sunaga, K., Ogoshi, S. PROTEIN SYNTHESIS IN SILK GLANDS. VI. RNA METABOLISM IN FIFTH INSTAR LARVAE. *Seikagaku Zasshi* (J.Biochem., Tokyo) 58, 3 (1966) 293-99.

When silkworms (*Attacus ricini*) were fed with ^{14}C-labelled orotate (I) during the early 5th instar stage, or when the posterior silkglands of the silkworm (*Bombyx mori*) were incubated during the same stage with I, only the nuclear RNA in the silk glands showed a high radioactivity. In the later 5th-instar stage, a fairly active incorporation was observed in the RNA of large particles, both in vitro and in vivo. The large particles contained three kinds of RNA: low-mol.wt. fibrous, and ribosomal RNA, with the base ratio of the fibrous type being different from the other two. The fibrous RNA was obtained in the fibrous form, and was eluted with saline similarly to DNA from a chromatographic column containing methylated albumin.(CA 63:1965, 16842a)

143 Muckenthaler, F.A. AUTORADIOGRAPHIC STUDY OF NUCLEIC ACID SYNTHESIS DURING SPERMATOGENESIS IN THE GRASSHOPPER, Melanoplus differentialis. Diss. Abstr. 25, 4 (1964) 2673-4.

Both squash preparations and sections were made of testes at measured time intervals after the animals had been injected with ^{3}H-labelled precurcors of the nucleic acids. Rate of incorporation was determined by a study of autoradiograms made with Kodak NTB-2 liquid emulsion. Incorporation of thymidine and adenine into DNA and adenine and uridine into RNA was used to determine the rate and time of synthesis of the nucleic acids. The length of the spermatogonial cell cycle is 28 h; DNA synthesis occupies 12 h of this. These figures are derived from the data on percentages of cells in mitotic metaphase which are labelled at different time intervals after injection of thymidine. A study of thymidine incorporation into cells in the premeiotic and meiotic stages indicates that DNA synthesis immediately prior to meiosis precedes the growth period of the spermatocytes and represents final synthesis of DNA in spermatogenesis. Since the spermatogonial cell cycle is approximately 28 h and the number of divisions is seven, these divisions should take about 8-9d. Meiosis takes 9-10 d and spermiogenesis 10 d as is indicated by labelling of recognizable stages of meiotic division and mature sperm respectively. The total time for the whole of spermatogenesis can then be computed to be approximately 28 d. The labelling pattern indicates that adenine is incorporated into an intermediate precursor of DNA, a low mol.wt. RNA being suggested as the most likely possibility. The synthesis of RNA was studied by comparing autoradiograms of unextracted preparations with those from which the RNA was extracted with ribonuclease. Labelling in the nucleus of the apical cell after adenine and uridine incorporation indicates a high rate of RNA synthesis in this cell. RNA synthesis in the spermatogonial cells occurs during the entire cell cycle except during the time corresponding to the middle stages of division. Considerable RNA synthesis occurs in prophase of meiosis and ceases during diakinesis. Synthesis of RNA then resumes after the second meiotic division and continues for a short time in the early spermatid until condensation of chromatin occurs. It is concluded that RNA synthesis depends on the physical state of the chromosomes since a consistent pattern in different types of cells shows that it occurs at all times except when the chromosomes are in a highly condensed state. (From abstr.)

144 Muckenthaler, F.A. AUTORADIOGRAPHIC STUDY OF NUCLEIC ACID SYNTHESIS DURING SPERMATOGENESIS IN THE GRASSHOPPER, Melanoplus differentialis. Expl Cell Res. 35, 3 (1964) 531-47.

For abstract, see ref. 143

145 Mukherjee, A.B. PATTERN OF DNA SYNTHESIS IN MOSQUITO CHROMOSOMES. Bull. ent. Soc. Am. 11, 3 (1965) 159. Abstr.102. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Fourth instar larvae of Aedes cataphylla Dyar where treated with thymidine-^{3}H (specific activity 1900 mCi/mM) for 2 h. Chromosome preparations were made from brain tissues following 2, 6, and 8 h of treatment. Autoradiographs were made using Kodak NTB$_3$ emulsion. All the three pairs of chromosomes were heavily labelled indicating synchronous replication of chromosomal DNA. 75% of the prophase nuclei were labelled (Abstr.)

146 Mukherjee, A.S., Beermann, W. SYNTHESIS OF RIBONUCLEIC ACID BY THE X-CHROMOSOMES OF Drosophila melanogaster AND THE PROBLEM OF DOSAGE COMPENSATION. Nature, Lond. 207 (1965) 785-6.

Experiments were designed to determine whether RNA synthesis by the X-chromosomes of male and female salivary glands operates at recognizably different levels, and if so, whether it is possible to evaluate the results in terms of repressing effect in females or an enhancing effect in males. For this purpose, short-pulse labelling with ^{3}H-uridine was used. The dissected salivary glands from the 3rd instar larvae of wild-type D. melanogaster ("Oregon R") were incubated in ^{3}H-uridine (2 μCi) in 10 μl of Drosophila Ringer for 5 min. The usual procedure of staining, squashing, and covering with stripping film, etc. was followed. Only chromosomes with similar puffing patterns were compared. The results showed that at the level of chromosomal RNA synthesis the single X-chromosome in males works with an efficiency close to that of the two X's in females. This suggests that dosage compensation operates at the level of information transfer from DNA to RNA. No conclusion can be drawn as to whether dosage compensation is a phenomenon involving repression or activation, i.e. works in the female or in the male.

147 Nash, D., Plaut, W., ON THE PRESENCE OF DNA IN LARVAL SALIVARY GLAND NUCLEOLI IN Drosophila melanogaster. J. Cell Biol. 27, 3 (1965) 682-6.

Fluorescent dyes and isotopic labelling were used to study nucleolar DNA. Isolated glands of mature 3rd instar larvae were incubated in modified Ringer with ^{3}H-thymidine (6000-16 000 μCi/mM) at a concentration of 5-15 μCi/ml) for 5-25 min. Squashed and fixed preparations were stained with aceto-orcein to facilitate good photographic recording. DNAse and RNAse were used. Nucleolar labelling was observed but the structural relationship between nucleolar DNA and chromosomal DNA is obscure.

148 Nicklas, R.B., Jaqua, R.A. X CHROMOSOME DNA REPLICATION, DEVELOPMENTAL SHIFT FROM SYNCHRONY TO ASYNCHRONY. Science, N.Y. 147, 3661 (1965) 1041-3.

Male grasshoppers (Melanoplus differentialis) were injected with thymidine-^{3}H and the testes were fixed, stained by the Feulgen reaction, squashed, and radioautographs prepared. The X-chromosome was negatively heteropycnotic in early spermatogonial cell generations and positively heteropycnotic in the final premeiotic interphase. Autoradiography showed that this condensation was paralleled by a delay in the time of DNA replication in the X-chromosome relative to that in the autosomes. (CA 62:1965, 13566a)

149 Nigon, V., Gillot, S. L'INCORPORATION DE LA THYMIDINE AU COURS DE L'OVOGENESE ET DU DEVELOPPEMENT EMBRYONNAIRE CHEZ LA DROSOPHILE. Expl Cell Res. 33 (1964) 29-38.

Une première série d'observations a montré que, dans l'ovogenèse de la Drosophile, la thymidine tritiée, fournie par injection, s'incorpore dans l'ADN nucléaire mais aussi dans des structures cytoplasmiques dont les unes sont sensibles à la ribonucléase, tandis que d'autres sont détruites par la désoxyribonucléase. Un jour après l'injection, l'intensité des marquages cytoplasmiques l'emporte largement sur celle des marquages nucléaires. Ces premières observations n'ont pu être retrouvées au cours de nombreuses expériences ultérieures utilisant des thymidines d'origines diverses marquées par le tritium ou par ^{14}C. Dans tous les cas, le marquage se localise essentiellement au niveau de l'ADN nucléaire. Il existe toutefois un certain marquage cytoplasmique qui résiste à l'action des nucléases. Dans les œufs en cours de développement, la thymidine libre s'incorpore dans l'ADN des noyaux en formation. En revanche, les substances cytoplasmiques marquées à la suite de l'injection de thymidine ne semblent pas participer à la synthèse de l'ADN. Diverses hypothèses sont émises pour expliquer la contradiction entre les résultats des deux ensembles d'observations effectuées. L'une des explications les plus vraisemblables se réfère à la possibilité de différences dans la constitution de thymidines tritiées appartenant à des lots différents. (Rés.)

150 Oberlander, H., Berry, S.J., Krishnakumaran, A., Schneiderman, H.A. RNA AND DNA SYNTHESIS DURING ACTIVATION AND SECRETION OF THE PROTHORACIC GLANDS OF SATURNIID MOTHS. J. expl Zool. 159 (1965) 15-31.

The mechanism of activation of the prothoracic glands in larvae and pupae of saturniid moths (Samia cynthia ricini and Antheraea polyphemus) was analysed, and changes examined which occur in the prothoracic glands during the larval-pupal and pupal-adult transformation. ^{3}H-thymidine and ^{3}H-uridine were used, and the techniques of injection (10 μCi/g and 5 or 10 μCi/g of body weight, respectively) and autoradiography are described. The glands in both moths synthesize DNA in the 4th instar, to a lesser extent in the 5th and in prepupae, and not at all in diapausing pupae or developing adults. The prothoracic glands appear to lose their ability to synthesize DNA during the larval-pupal transformation. The prothoracic glands of Samia synthesized RNA at a high rate throughout the 4th larval instar. The rate of synthesis RNA in A. polyphemus in developing adults was several times greater than the rate of RNA synthesis in diapausing pupae. Injection of juvenile hormone caused a marked increase in the rate of RNA synthesis. Changes in the rate of RNA synthesis were correlated with cytological changes in developing adults and in pupae injected with juvenile hormone extract. Prothoracic gland cells were found in adult Samia. Some of the cells were degenerating while the others appeared inactive. The relationship of RNA synthesis to activation and secretion, and the significance and control of DNA synthesis in the prothoracic glands are considered. Preliminary work on protein synthesis in the glands and their activation in vitro is evaluated.

151 Ogoshi, S. FIBROIN SYNTHESIS IN POSTERIOR SILK GLANDS. VI. METABOLIC CHANGES IN RNA DURING THE FIFTH INSTAR. Seikagaku Zasshi (J. Biochem., Tokyo) 57 (1965) 209-16.

By isotopic experiment with orotic-^{14}C acid incorporation using posterior silk glands at the 5th instar stage, max. ^{14}C incorporation was observed in the large particles of the microsome fractions. In the posterior silk glands at the 5th instar, DNA-like RNA was present, as demonstrated by the fractionation in a methylated albumin column, and the base composition of this particular RNA was different from that of ribosomal RNA (CA 63:1965, 13744g)

152 Olivieri, G., Olivieri, A. AUTORADIOGRAPHIC STUDY OF NUCLEIC ACID SYNTHESIS DURING SPERMATOGENESIS IN Drosophila melanogaster. Mutation Res. 2,4 (1965) 366-80.

The incorporation of ^{3}H-uridine and ^{3}H-thymidine in the D. melanogaster testes was studied autoradiographically. RNA synthesis was observed in spermatogonia and young spermatocytes. At 30 min after ^{3}H-uridine injection only the nucleus and nucleolus appeared labelled; at 2-4 h post injection (p.i.), labelling was also observed in the cytoplasm. At 8 h p.i. labelling was very heavy in the cytoplasm and lighter in the nucleolus, while it disappeared altogether in the nucleus. At 4 d p.i., labelling was transmitted to the cytoplasm of spermatids and at 6 d to sperm; it disappeared in the final stages of maturation, when these cells were no longer arranged in bundles. In the post-meiotic stages no RNA synthesis was observed. The non-germ line cells showing RNA synthesis were: testis coat cells, cyst cells, terminal epithelium cells and seminal vesicle wall cells. Direct RNA synthesis was not observed in nutritive cells. DNA synthesis was observed in spermatogonia as early as 30 min after ^{3}H-thymidine injection. By contrast, ^{3}H-thymidine labelling in spermatocytes was rarely observed, even at 8 h after injection, and then only in the very young spermatocytes. An analysis of the data from several other organisms on RNA metabolism in the course of meiosis has shown that RNA synthesis always occurs in the primary spermatocytes; by contrast, RNA synthesis does not always occur in post-meiotic stages and thus does not seem to be an essential step during spermiogenesis. (Auth.)

153 Onodera, K., Komano, T., Kurosawa, S., Yamamoto, K. PRESENCE OF A DIFFERENT SEQUENCE IN THE TERMINAL REGION OF GLYCINE-SPECIFIC (TRANSFER RNA). Agric.biol.Chem., Tokyo 29, 7 (1965) 693-95.

The title RNA (I) was isolated from the posterior silk gland of Bombyx mori. I and glycyl-tRNA synthetase were incubated with uniformly labelled L-^{14}C-glycine in a suitable medium. The separated product was digested with RNase, the digest chromatographed on DEAE-cellulose, and eluted with the linear gradient 0.01-0.6 M $HCOONH_4$ at pH 6.5. Counts of eluate fractions showed two radioactive peaks (II, III) issuing, respectively, at 0.025 and 0.035 M, initially and on rerun with 0.01-0.04 M gradient. On high-voltage paper electrophoresis, III moved ahead of II; u.v. absorptions and scanner peaks approximately coincided. I has a heterogeneous nucleotide sequence between the terminal nucleotides and the first guanylic acid in the chain. (CA 63:1965, 10190g)

154 Onodera, K., Komano, T. GLYCINE-SPECIFIC TRANSFER RIBONUCLEIC ACID (t-RNA) IN THE POSTERIOR SILK GLAND OF Bombyx mori. Biochim. biophys. Acta 87, 2 (1964) 338-40. (In English)

^{14}C-labelled amino acids and t-RNA prepared from the posterior silk gland of B. mori were studied in relation to the isolation of glycine-specific t-RNA. ^{14}C-glycine and ^{14}C-alanine were predominantly incorporated into t-RNA under the conditions investigated, while ^{14}C-serine, aspartic ^{14}C-acid and glutamic ^{14}C-acid were incorporated to a lesser extent. (CA 61:1964, 7422e)

155 Painter, R.R., Kilgore, W.W. INCORPORATION OF GLYCINE-2-C-14 INTO UNTREATED AND CHEMOSTERILANT TREATED HOUSE FLIES. Bull. ent. Soc. Am. 11, 3 (1965) 178. Abstr.479 Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec.1965".

The RNA of the eggs oviposited by normal house flies fed labelled glycine contained ^{14}C primarily in adenylic and guanylic acids. Thiotepa-sterilized house flies oviposited eggs with less ^{14}C incorporated into the RNA. (Abstr.)

156 Pavan, C., NUCLEIC ACID METABOLISM IN POLYTENE CHROMOSOMES AND THE PROBLEM OF DIFFERENTIATION. p.222-41 of "Genetic Control of Differentiation. Brookhaven Symposia in Biology No.18, 7-9 Jun.1965". BNL-931 (C-44), Brookhaven National Lab., Upton, N.Y. 1965, 270p.

Data on polytene chromosomes obtained for cells of different tissues in the same or different stages of development and the information provided on the patterns of gene action during differentiation are reviewed. The chemical changes occurring during the swelling of certain chromosome regions which are related to the synthesis and accumulation of DNA, RNA, and protein in specific loci at certain times of development were analysed by injecting labelled precursors (^{3}H-thymidine, ^{3}H-uridine, ^{3}H-cytidine) into the larva. Data from a comparative study of (polytene chromosome) nucleic acid metabolism of different organs (salivary gland, Malpighian tubules, some cells of the median intestine, and several other glands) of Rhynchosciara angelae, under normal as well as some abnormal conditions are discussed. The syntheses of RNA and DNA are evidently discontinuous. The interval in the cycle of RNA synthesis appears to be much shorter. The existence of metabolic DNA is discussed. The main process occurring in most polytene chromosome puffs is RNA synthesis; the extra synthesis of DNA in specific loci of the chromosomes is, however, well documented for at least R. angelae and Sciara coprophila.

157 Pavan, C. SYNTHESIS. p.335-42 if "Genetics Today. Proceedings of the 11th International Congress of Genetics, The Hague, Netherlands, Sep.1963, Vol.2". Geerts, S.J., Ed, Oxford, Pergamon Press.1965.

Summary of several papers. Some data are presented on polytene chromosomes of Rhynchosciara angelae obtained with tritiated precursors of RNA and DNA, and the significance of the results to interphase chromosomes generally is discussed.

158 Pelling, C. RIBONUKLEINSÄURE-SYNTHESE DER RIESENCHROMOSOMEN VON Chironomus tentans. (RNA synthesis by the giant chromosomes of Chironomus tentans). Chromosoma 15, 1 (1964) 71-122. (In German, with English summary)

This investigation was carried out on the salivary gland nuclei of the 4th instar larvae of C. (Camptochironomus) tentans and led to the identification of 277 RNA-containing structures which were specified in the revised chromsome map. Up to two thirds of these bands appear together at any one time within a nucleus. The average amount of RNA in strongly expanded structures (e.g. Balbiani rings and big puffs) is greater than that of the weakly puffed bands. RNA of the puffed regions is synthesized in situ. ^{3}H-uridine injection showed these bands to be specifically labelled. The label as well as the metachromatic coloration of the toluidine blue stain is sensitive to RNase. Alterations of the puff pattern, i.e., changes in the degree of puffing of a band are accompanied by differences in incorporation. A general relationship exists between the rate of synthesis and the size of a puff. RNA production increases with the size of these structures. The phenomenon of puffing should therefore be understood as a mechanism regulating the amount of RNA produced by a locus. Each of the three large chromosomes: I, II, and III (including up to 90 active bands each) synthesizes as much RNA as one of the two big Balbiani rings in full development or as much as each of the two nucleolar organizers. Nucleolar incorporation mostly starts from the area attached to the chromosome and then extends to the periphery. This observation supports the view that the DNA-rich portions of the nucleolus, the nucleolus organizer proper, are concerned with the synthesis of the nucleolar RNA. Despite considerable individual flutuations, (average) uridine incorporation increases with time, possibly reflecting changes in the rate of RNA synthesis.

159 (2) Peters, G. EINFLUSS DES METAMORPHOSEHORMONS ECDYSON AUF DEN NUCLEINSÄURESTOFFWECHSEL VON Calliphora LARVEN. (The effect of ecdyson, the hormone of metamorphosis on nucleic acid metabolism in Calliphora larvae). Thesis. Naturwissenschaftliche Fakultät, Ludwig-Maximilians-Universität, Munich 1963, 70p. (In German)

Existing techniques for isolating nucleic acids were adapted for blowfly (C. erythrocephala) tissue and the results obtained evaluated critically. Incorporation of ^{32}P (from phosphate) in RNA was increased from 50-80% by ecdysone. This effect reached a max. 4-7 h after injection. Data were obtained indicating a negative influence of ecdysone on the storing of certain substances. The distribution of activity in individual nucleotides is different according to whether ecdysone is present or not. Results confirm the hypothesis of the action mechanism of the hormone according to which the genetic material is first activated; subsequently, in a second phase, specific nucleic acids are produced.

160 Plaut, W., Nash, D. LOCALIZED DNA SYNTHESIS IN POLYTENE CHROMOSOMES AND ITS IMPLICATIONS. p.113-35 of "The Role of Chromosomes in Development. Proceedings of the 23rd Symposium of the Society for the Study of Development and Growth, Amherst, Mass., June 1964". Locke, M., Ed. New York, Academic Press.1964, 290p.

Incubation of salivary glands of Drosphila melanogaster with ^{3}H-thymidine is reported to result in labelling of interband regions.

161 Pollister, A.W. AN AUTORADIOGRAPHIC STUDY OF RNA SYNTHESIS IN ISOLATED SALIVARY GLANDS OF Drosophila hydei. II. INTERFEROMETRIC STUDIES. J. Morph. 116, 1 (1965) 89-98.

Interferometric measurements were made on sections of salivary glands mounted in oils of refractive indices 1.410, 1.460, and 1.500, estimating optical path differences as fringe displacement with a Leitz double-beam interferometer microscope. From these data the mean concentrations (in mg/cm^{2}/µm) of 55 cells of three glands were computed as follows: karyoplasm, 0.027 ± 0.0026; cytoplasm, 0.048 ± 0.0024; nucleolus, 0.066 ± 0.0041. From these concentrations it was computed, according to Maurer and Primbsch (Expl Cell Res. 33: 1964, 8) that the correction factors for four micron sections were: karyoplasm, 0.203; cytoplasm, 0.114; nucleolus, 0.083. The reciprocals of these fractions (5.0, 8.8, and 12.0) are the correction factors of Arnold (ibid, 65) by which measured silver grain densities on autoradiographs are multiplied to give corrected (i.e.potential) densities. (Auth.)

162(2) Ramamurty, P.S. ÜBER DIE HERKUNFT DER RIBONUKLEINSÄURE IN DEN WACHSENDEN EIZELLEN DER SKORPIONSFLIEGE Panorpa communis (INSECTA, MECOPTERA). (On the origin of the RNA in the growing egg cells of Panorpa communis (Insecta, Mecoptera)). Naturwissenschaften 50, 10 (1963) 383-4.

On the basis of experiments with ^{3}H-uridine it was possible to demonstrate that the major source of RNA-synthesis is the cell-nucleus of the egg-nutrition cells (3 nutrition cells + 1 oocyte = an egg-nutrition unit) from which it passes through the nutrition-cell cytoplasm into the oocyte via fusomes. Some RNA is formed by the oocyte nucleus during the later stages of the maturation process, while the follicle epithelium in which the egg is embedded is a third source. (Ba 45: 164, 35543)

163 Ramenskaya, G.P. THE INCORPORATION OF URIDINE-^{3}H INTO THE CELLULAR STRUCTURES OF THE SILK GLAND AND THE EFFECT ON THIS PROCESS OF ACTINOMYCIN D. Tsitologiya 7, 1 (1965) 88-90. (In Russian)

Silkworms at 2 and 7 d of the 5th growth cycle received 12.5 γ actinomycin D/worm (approximate weight 2 g), and 15 min later, uridine-^{3}H at a dose of 4 µCi/worm. Control worms received the uridine-^{3}H only. The incorporation of uridine-^{3}H into RNA was studied on sections of the fibroin part of the silk gland by the usual staining techniques and autoradiography. In the first series, the incorporation of the RNA precursor into the cell nuclei occurred in the control silkworms within 15 min after its introduction. After 18 h, the radioactivity in the nucleus decreased and appeared in the cytoplasm. There was no incorporation of uridine-^{3}H in worms receiving actinomycin D. In the second series, there was no incorporation in either the test or the control silkworms. Thus, the synthesis of RNA takes place in the silk gland during the 1st half of the 5th growth cycle, when it accumulates in the nucleus. Subsequently, the RNA is transferred into the cytoplasm. Actinomycin D completely inhibits the synthesis of RNA (CA 63:1965, 2166d)

164 Ritossa, F.M. BEHAVIOUR OF RNA AND DNA SYNTHESIS AT THE PUFF LEVEL IN SALIVARY GLAND CHROMOSOMES OF Drosophila. Expl Cell Res. 36, 3 (1964) 515-23.

Synthetic activities at the puff level in salivary gland chromosomes of Drosophila buskii were studied by autoradiographic methods. The analyses were carried out both on normally occurring and on experimentally induced puffs. All the puffs in this material appear to be sites of intense RNA synthesis (high incorporation of ^{3}H-uridine and ^{3}H-cytidine, an almost complete loss of this radioactivity after RNase digestion, and a loss of label (^{3}H-cytidine) after puff regression). On pulse labelling with ^{3}H-thymidine to test DNA synthesis in the salivary gland cells, some chromosomes appear continuously labelled along their length, while others are discontinuously labelled. The discontinuously labelled chromosomes are shown to be a phase in DNA duplication. DNA and RNA synthesis are certainly not mutually exclusive within the entire nucleus and probably not within an individual puff.

165 Ritossa, F.M., Borstel, R.C. von, Swift, H. THE ACTION OF RIBONUCLEASE ON SALIVARY GLAND CELLS OF Drosophila. Genetics 50 (1964) 279.

Ribonuclease induces up to 40 new puffs in polytene chromosomes after a 5 h exposure of excised glands in a solution containing the enzyme; only remnants of the nucleolus remain after this treatment. In the course of isotopic labelling experiments, three principal observations were made: (1) after ribonuclease action in vivo, a certain amount of uridine labelling still remains in very active, normally occurring puffs (although much less than when ribonuclease is absent) and in the puffs induced by ribonuclease itself; (2) the nucleolus organizer region and nucleolar remnants are labelled; and (3) ribonuclease inhibits amino acid incorporation into protein after 2 h of incubation. Paradoxically, ribonuclease-induced puffs stained metachromatically with azure B are much more intense in colouration than are the untreated, normal puffs in control glands. We know that entry of uridine into the cell is not hindered by ribonuclease, therefore we conclude that ribonuclease breaks down cellular RNA, which adds to the nucleotide pool, effectively diluting the added, labelled uridine. From the observation of inhibition of amino acid incorporation by ribonuclease after a 2 h treatment and the observation that puffs are induced by ribonuclease by 5 h of treatment, it can be firmly concluded that the protein of the puffs pre-exists and is not formed during the process of puff production.

166 Ritossa, F.M., Pulitzer, J.F., Swift, H., Borstel, R.C. von. ON THE ACTION OF RIBONUCLEASE IN SALIVARY GLAND CELLS OF Drosophila. Chromosoma 16, 2 (1965) 144-51.

Third instar larvae of Drosophila buskii were used throughout. Ribonuclease was shown to degrade the nucleolus in actively metabolizing cells. It does this without inhibiting RNA synthesis in the puffs and the nucleolus organizer. DNA synthesis still continues before or after puff formation, while amino acid incorporation is inhibited before the puffs are formed, indicating pre-existence of proteins involved in the process of puff formation. The effect of ribonuclease in RNA and RNA synthesis was studied by using ^{3}H-uridine (specific activity 4 Ci/mM); the effects of RNAse on amino acid incorporation were studied by means of tritiated L-histidine (specific activity 1.1 Ci/mM), L-lysine (0.4 Ci/mM), L-phenylalanine (1.65 Ci/mM), L-leucine (0.5 Ci/mM), and DL-tryptophan (0.6 Ci/mM); and on DNA synthesis, using ^{3}H-thymidine (6 Ci/mM).

167 Robert, M., Kroeger, H. LOKALISATION ZUSÄTZLICHER RNS-SYNTHESE IN TRYPSIN-BEHANDELTEN RIESENCHROMOSOMEN VON Chironomus thummi. (Localization of the additional RNA synthesis in trypsin-treated giant chromosomes of Tendipes thummi). Experientia 21, 6 (1965) 326-7. (In German, with English summary)

After injection of buffered trypsin into nuclei of salivary gland cells of T. thummi the existing puffs in the giant chromosomes are enlarged. Autoradiography shows an increase in RNA synthesis in the puffs, which is about threefold. ^{3}H-uridine was used. The presence of histone may normally block RNA synthesis but in the puffed segments the histone is in a form which does not block and, at the same time, is particularly susceptible to trypsin digestion.

168 Russo-Caia, S. RECENT AUTORADIOGRAPHIC OBSERVATIONS ON THE INCORPORATION OF LABELED PRECURSORS OF NUCLEIC ACIDS AND PROTEINS IN THE FATTY BODIES OF Musca domestica. Atti. Accad. naz. Lincei Rc. Classe di scienze fisiche, matematiche e naturali 37, 6 (1964) 518-20. (In Italian)

Previous autoradiographic studies on the incorporation of ^{14}C-labelled adenine and orotic acid into the trophocytes of the larval fatty bodies of M. domestica are extended to the in vitro incorporation of tritiated precursors of nucleic acids and proteins. Fatty bodies isolated from stage III larvae were maintained in Case's physiological solution for Diptera (Lockwood, CA 55, 14554c) containing ^{3}H-uridine (I), ^{3}H-cytidine (II) or ^{3}H-orotic acid (III) as nucleic acid precursors, or phenylalanine-^{3}H (IV) as protein precursor. These substances were added to a concentration of 5 or 10 μCi/ml, and their incorporation examined after 10-15 min, 60 min, and 7-8 h when fragments were fixed in Bouin's fluid, embedded, and sectioned 6-7 μm thick. The sections were exposed for 7-15 d on plates coated with Ilford L4 emulsion as described by Russo-Caia (CA 60, 16255e) and were finally stained with methyl greenpyronine. With I, II, and III the trophocyte nuclei were faintly marked after 15 min, more so after 1 h when some cytoplasmic granules were also marked, and strongly after 7-8 h (in some cases completely covered by granules), the cytoplasm also showing a uniform distribution of radioactivity. There was no significant difference in intensity between I, II, and III. Incorporation of IV was chiefly in the cytoplasm after 15 min, increasing with time so that after 7-8 h marked granules were present in the nuclear area. These results show an active metabolism of the RNA synthesized in the nucleus and passed to the cytoplasm in the larval fatty body cells and this metabolism is accompanied by protein synthesis, demonstrated by incorporation of IV. These materials elaborated in and by the larval fatty bodies serve during metamorphosis for the formation of the imago. (CA 63:1965,6067ac)

169 Schiff, S.O. RIBONUCLEIC ACID SYNTHESIS IN NEUROBLASTS OF THE GRASSHOPPER Chortophaga viridifasciata. Diss. Abstr. 25, 9 (1965) 5459.

Experiments were designed to study various aspects of RNA synthesis, particularly in relation to the mitotic cycle in grasshopper neuroblasts. Living cells were observed in hanging drop preparations, and part of these were carefully mapped as to their location in the embryo, so that they could be reidentified in fixed and stained sections. In this way the progress of individual cells through mitotic stages could be ascertained with precision, and the effects of exposure to a labelled riboside observed. Autoradiography was employed, using ^{3}H-uridine as a precursor of RNA, and the distribution and density of silver grains in emulsion over cells was studied. Analysis of 763 cells lead to the following conclusions: (1) ^{3}H-uridine is incorporated into RNA molecules which are extractable by RNase digestion; (2) RNA synthesis begins in middle telophase, 9 min after appearance of nucleoli, and continues to approximately the middle part of middle prophase; (3) RNA synthesis begins simultaneously in chromosomes and nucleoli, and nuclear RNA synthesis precedes the appearance of label in the cytoplasm; (4) during those stages in which nuclear RNA synthesis takes place, most of the cellular label is associated with chromosomes and nucleoli; (5) the structures most densely labelled are the nucleoli; (6) cytoplasmic labelling is observed only in cells fixed in very late prophase, mid-mitotic stages, and early telophase, after 40 or more min of exposure to ^{3}H-uridine; (7) label moves from nucleus to cytoplasm beginning in very late prophase, and some of it probably returns to the nucleus during middle telophase; (8) from middle to late anaphase most of the cytoplasmic label lies in the spindle between separating chromosomes; (9) the grain density over cells, which reflects the amount of ^{3}H-uridine incorporated, is decreased by increasing the tonicity of the culture medium. (DA)

170 Schiff, S.O. RIBONUCLEIC ACID SYNTHESIS IN NEUROBLASTS OF Chortophaga viridifasciata (De Geer), AS DETERMINED BY OBSERVATIONS OF INDIVIDUAL CELLS IN THE MITOTIC CYCLE. Expl Cell Res. 40, 2 (1965) 264-76.

All embryos except controls were exposed to 40 μCi/ml of ^{3}H-uridine with a specific activity of 2.77 Ci/mM. Embryos were incubated at 38°C in hanging drops for 10-40 min in medium containing ^{3}H-uridine, and fixed immediately. Analysis of 783 mapped and unmapped neuroblasts leads to the following conclusions: ^{3}H-uridine is incorporated into RNA molecules which are extractable by RNase digestion. RNA synthesis begins in the middle of middle telophase, 9 min after appearance of nucleoli, and continues to approximately the middle part of middle prophase. RNA synthesis begins simultaneously in chromosomes and nucleoli, and nuclear RNA synthesis precedes the appearance of label in the cytoplasm. During those stages in which nuclear RNA synthesis takes place, most of the cellular label is associated with chromosomes and nucleoli. The nucleoli are the most densely labelled structures in the neuroblast. Cytoplasmic labelling is prominent only in cells fixed in very late prophase and mid-mitotic stages, after an exposure to ^{3}H-uridine of more than 20 min. The uptake of ^{3}H-uridine is decreased by incubating neuroblasts in hypertonic culture medium.

171 Schneiderman, H.A., Gilbert, L.I. CONTROL OF GROWTH AND DEVELOPMENT IN INSECTS. Several growth hormones appear to be isoprenoid derivatives, and some may act upon the cell nucleus. Science, N.Y. 143 (1964) 325-33.

Article reviews recent results. Findings from numerous studies are discussed, among them some results obtained autoradiographically (including some unpublished work, as also table 3 on the rate of uptake of ^{3}H-uridine into pupae of Hyalophora cecropia). They suggest (1) ecdysone, juvenile hormone, gonadotropic hormone, and perhaps the brain hormone may be related chemically; (2) these substances may all be polyisoprenoid derivatives; (3) the juvenile hormone and the brain hormone may act directly on many tissues to cause growth without ecdysone; and (4) the possibility remains that the mechanism whereby the juvenile hormone activates the prothoracic glands is totally different from the mechanism whereby the brain hormone activates the prothoracic glands; and the brain hormone may turn out to resemble the more conventional neurosecretory polypeptides (e.g. oxytocin and vasopressin).

172 Sekeris, C.E., Dukes, P.P., Schmid, W. WIRKUNG VON ECDYSON AUF EPIDERMISZELLKERNE VON Calliphora-LARVEN IN VITRO. (Effect of ecdysone on nuclei of epidermal cells of Calliphora larvae in vitro). Hoppe Seyler's Z. physiol. Chem. 341, 1-3 (1965) 152-4. (In German, with English summary)

Epidermis nuclei isolated from 7-d-old larvae of C. erythrocephala incorporate [2-^{14}C]uracil into RNA. Addition of the insect hormone ecdysone to the incubation mixture leads, within 15 min, to a considerably increased incorporation of uracil into RNA over that of controls. (Auth. summary)

173 Sekeris, C.E., Dukes, P.P., Schmid, W. THE ACTION OF ECDYSONE ON NUCLEIC ACID METABOLISM IN INSECTS. Biochem. J. 97, 3 (1965) 23P-24P. Abstr. Presented at the "453rd Meeting of the Biochemical Society, Middlesex Hospital, Medical School, England, 8 Oct. 1965".

Recent studies on the structure and role of ecdysone, a C_{27}-7(8)-en-6-oxo-steroid, and the latest results are cited. Radioisotopes were used in a number of studies. RNA synthesis in the epidermis of Calliphora erythrocephala larvae was studied under the influence of ecdysone. Using the method of Georgiev & Mantieva (Biochim. biophys. Acta 6: 1962, 153) two nuclear fractions were obtained, one at 0°-50°C corresponding mainly to ribosomal and transfer RNA, and one at 65°C possessing the characteristics of messenger RNA. Incorporation of labelled precursors into RNA and template activity of the isolated RNA were taken as criteria to judge the effects of the hormone. The stimulation of ^{32}P-incorporation into both nuclear RNA fractions within 1 h of ecdysone administration, and into cytoplasmic RNA within 3-4 h could be demonstrated. The response of isolated epidermis nuclei to ecdysone was studied by means of [2-^{14}C]uracil incorporation into RNA. Template activity of the RNA was also stimulated in the presence of ecdysone.

174 Sekeris, C.E., Lang, N., Karlson, P. ZUM WIRKUNGSMECHANISMUS DER HORMONE. V: DER EINFLUSS VON ECDYSON AUF DEN RNA-STOFFWECHSEL IN DER EPIDERMIS DER SCHMEISSFLIEGE Calliphora erythrocephala. (The mechanism of action of hormones. V. The effect of ecdysone on RNA metabolism in the epidermis of the blowfly, Calliphora erythrocephala). Hoppe-Seyler's Z. physiol. Chem. 341, 1-3 (1965) 36-43. (In German, with English summary)

The turnover of nucleic acids in the epidermis of C. erythrocephala is increased by the insect hormone ecdysone; the incorporation of $H^{32}PO_4^{2}$-into ribosomal and messenger RNA of the cell nucleus is increased. The m-RNA fraction from hormone-treated animals has a higher messenger activity than that from controls, measured by the stimulation of protein synthesis in an in vitro system. In connection with the earlier finding of the hormone-dependent synthesis of the messenger RNA for Dopa decarboxylase, it is concluded that ecdysone stimulates enzyme production by stimulating the DNA-dependent RNA synthesis. (Auth. summary)

175 Smirnov, V.N., Spirin, A.S., Kullyev, P., Zbarskiĭ, I.B. RIBONUCLEIC ACID SYNTHESIS OF SILK-SECRETING GLAND OF Bombyx mori. Dokl. Akad. Nauk SSSR 155, 4 (1964) 957-60.

Centrifugal examination of RNA of the silk gland with ^{32}P showed that a large component of ribosomal RNA, a small component of ribosomal RNA, and a small component of soluble RNA make up the tagged RNA isolated from the organ, as shown by spectrophotometry; radiographic study showed four peaks, which failed to coincide with the spectrophotometric peaks. The period of max. synthesis of fibroin coincides with the period of almost total lack of RNA synthesis by the organism. Rapidly-tagged RNA exists mainly at the start of the fifth period of development, i.e. during the synthesis of most of RNA. This indicates that this form of RNA is not the short-lived messenger RNA but a precursor of the stable RNA which accumulates in the cells during this growth period (CA 61: 1964, 1010d)

176 Szafrański, P., Lutowicz, J., Puźyńska, L. THE RIBONUCLEIC ACID FROM THE SILK GLAND OF THE SILKWORM AND THE AMINO ACID CODE. Acta biochim. pol. 11, 1 (1964) 71-81. (Polish summary)

^{32}P-labelled RNA was isolated by the phenol method; from ECTEOLA-cellulose column three and two fractions of RNA were obtained from the posterior and the middle part of the gland, respectively. The nucleotide composition of each fraction was compared with the composition of mRNA calculated from the amino acid content of silk protein by doublet, triplet and mixed codes. The composition of mRNA for sericin (doublet code) is similar to that of RNA from the middle part of the gland. In a cell-free preparation from E. coli, RNA from the middle part stimulated the incorporation into protein of the ^{14}C-labelled amino acids specific for sericin, i.e. serine, glycine and glutamic acid. (Auth.)

177 Taylor, J.H. DISTRIBUTION OF TRITIUM-LABELED DNA AMONG CHROMOSOMES DURING MEIOSIS. I. SPERMATOGENESIS IN THE GRASSHOPPER. J. Cell Biol. 25, 2, Pt. 2 (1965) 57-67.

Thymidine-H^3 of high specific activity was used to study the distribution of labelled chromatids during meiotic divisions in spermatocytes of Romalea microptera (Beauvoir), a species of grasshopper (Orthoptera). The distribution is regularly semiconservative as has been shown previously for mitosis, i.e., all chromatids are labelled after incorporation of thymidine-H^3 into DNA at premeiotic interphase. If incorporation occurs at the interphase preceding this one, the chromosomes arrive at meiotic divisions with the equivalent of one chromatid of each homologue labelled. Chromatid exchanges occur at a frequency which is very nearly that predicted on the assumption that each chiasma represents an exchange between homologous chromatids. However, the exchanges are randomly distributed among chromosomes in a size group, whereas chiasmata are not. A quantitative analysis of the frequency and pattern of exchanges indicates that most of these result from breakage and reciprocal exchange between homologous chromatids. Sister chromatid exchanges are much less frequent and may be limited to premeiotic stages. (Essentially auth.)

178 Urbani, E., Russo-Caia, S. CYTOCHEMICAL AND AUTORADIOGRAPHIC OBSERVATION OF NUCLEIC ACID METABOLISM IN THE OOGENESIS OF Dytiscus marginalis. Rend. Ist. Sci Univ. Camerino 5, 1 (1964) 19-50. (In Italian, with English summary)

Ovary slices of D. marginalis were fixed with EtOH, mounted with gelatin, dehydrated with increasing concentrations of EtOH, and placed 2 h in concentrated solutions of thymidine, uridine, or phenylalanine. Emulsions were added and developed. Cytochemical determinations were made by fluorescent microscopy. Thymidine-^{3}H, thymidine-^{14}C, uridine-^{3}H, and phenylalanine-^{3}H were injected at different times to study nucleic acid metabolism. A cytochemical and morphological study of an extrachromosomal body which is included only in the oocyte, and not in the nurse cells, was made. The incorporation of uridine-^{3}H revealed that while ribonucleic acid metabolism was simultaneous in all nurse cells, DNA synthesis occurred at different rates in each cell. (CA 61: 1964, 8676f)

179 Vanderberg, J.P. SYNTHESIS AND TRANSFER OF DNA, RNA, AND PROTEIN DURING VITELLOGENESIS IN Rhodnius prolixus (HEMIPTERA). Biol. Bull. 125 (1964) 556-75.

Histochemical and autoradiographic techniques demonstrated that DNA was synthesized in the nuclei of the ovary, fat body, and midgut. The autoradiographic localization of sites of incorporation of ^{3}H-labelled precursors into DNA, RNA, and protein was analysed by injection 5 μCi ^{3}H-thymidine (1900 mCi/mM) for determining DNA-, 5μCi ^{3}H-uridine (3280 mCi/mM) for RNA-, or 10 μCi DL-leucine-4,5-^{3}H (3570 mCi/mM) for determining protein-synthesis. The dilution of the radioactive solutions was such that each insect received 0.01 ml/injection. There appeared to be a transfer of some of the DNA in a partially depolymerized form from the ovarian trophic tissues

to the growing oocyte. RNA was synthesized in the nuclei of the ovary, fat body, and midgut, and then was transferred to the cytoplasm. Some of the RNA passed from the ovarian trophic tissues to the growing oocyte. Protein was synthesized most actively in the ovarian follicular epithelium, and in the fat body. Newly synthesized protein was transferred from the follicular epithelium to the oocyte. Synthesis of yolk protein by the oocyte itself appeared to be neglible. (Auth.)

180 Ward, D.N. MEETINGS. CANCER RESEARCH. The "19th Annual Symposium on Fundamental Cancer Research, Houston, Tex., 4-6 Mar. 1965", * is summarized by the author. Science, N.Y. 150 (1965) 1063-75.

H. Laufer discussed relationships between chromosomal puffing and cellular function during insect development. The insect Chironomus thummi was studied during the larval-pupal transformation. Several enzymes were studied in the differentiating salivary glands. Although some of the enzyme changes correlated with puffing in the Balbiani rings of the chromosomes in the salivary gland, tracer studies and immunochemical isolations led Laufer to conclude that tissue specificity of the enzymes was not great enough to account for the specificity of the puffing. To circumvent this dilemma, Laufer proposes that the activity of the Balbiani ring correlates with the production of a transport system in the salivary gland, which in turn moves enzymes from other parts of the insect circulation and into the secreted product of the gland.

181 Watkins, M.J. EVIDENCE FOR A LAMPBRUSH TYPE STRUCTURE IN GRASSHOPPER SPERMATOCYTE CHROMOSOMES. Expl Cell Res. 36, 1, (1964) 14-18.

Prophase chromosomes in spermatocytes of the grasshopper, Melanoplus differentialis, resemble the lampbrush chromosomes of amphibian oocytes in being long, thin and extremely diffuse. Previous microinterferometric measurements of the dry mass of these chromosomes showed an apparent increase in mass during diakinesis to the expected value at metaphase. The measured dry mass is the same for chromosomes in prophase, metaphase and anaphase of mitosis. It is suggested that the apparent increase in mass during diakinesis is due to the regression of loops or strands of chromosome material which cause the diffuse appearance in diplotene chromosomes. Autoradiographic studies show that chromosomes in grasshopper spermatocytes further resemble lampbrush chromosomes in the incorporation of ^{3}H-uridine around the chromosomes while they are in the diffuse state. The technique used is described in detail. The ^{3}H-uridine (specific activity 0.68 Ci/mM) and DL-phenylalanine-^{3}H (specific activity 33.2 mCi/mM) were used at a concentration of 500 μCi/ml.

182 Wyatt, G.R., Linzen, B. THE METABOLISM OF RIBONUCLEIC ACID IN CECROPIA SILKMOTH PUPAE IN DIAPAUSE, DURING DEVELOPMENT AND AFTER INJURY. Biochim. biophys. Acta 103, 4 (1965) 588-600.

RNA metabolism in tissues of Hyalophora cecropia was studied by injecting ^{32}P and the amount of RNA, its total base composition, the rate of incorporation, and the content of ^{32}P in the four ribonucleotides was estimated. In wing tissue, incorporation of phosphate into RNA was elevated during the first week of development towards the adult, but by day 13, when protein synthesis is still highly active, RNA synthesis had returned to the diapause rate (see Table I). After injection of ecdysone into brainless pupae, RNA synthesis was stimulated somewhat at 4 h and strongly at 24 h. Integumentary injury also accelerated RNA synthesis (Table II). In fat body incubated in vitro, phosphate incorporation into RNA appeared elevated at the earliest stages of adult development (Table III). After injury, incorporation was maximal after 1 d and declined whereas the rate of protein synthesis continued to rise for a week. In both tissues the composition of rapidly synthesized RNA, estimated from pulse incorporation of ^{32}P in the nucleotides, was different from the bulk RNA and distincly DNA-like, suggesting template RNA. No change in either bulk or new RNA composition was detected in development or after injury. DNA was prepared from Cecropia wing tissue and found to have an A+T/G+C ratio of 1.8.

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* Full text of papers is being published as a monograph "Developmental and Metabolic Control Mechanisms and Neoplasia".

See also:

16 The effect of tritiated thymidine and gamma irradiation on the mortality of adult Drosophila melanogaster. (Kent, E., 1965)
19 Some physiochemical indexes of gaseous exchange in the housefly Musca domestica and of DNA nucleotide composition of first-generation larvae, following internal β-irradiation by phosphorus-32. (Kharlamov, V.P., 1964)
22 Mutagenic effect on mature Drosophila spermatozoa of ^{32}P incorporated into DNA. (Lee, W.R. et al., 1965)
23 The mutagenic effect of tritiated uridine in Drosophila spermatocytes. (Olivieri, G., Olivieri, A., 1965)
56 Structure and function of interphase chromosomes. (Beermann, W., 1965)
57 Cytoplasmic synthesis of nuclear histone during spermiogenesis in the grasshopper Chortophaga viridifasciata (de Geer). (Bloch, D.P., Brack, S.D., 1964)
61 Actinomycin and puromycin: effects on sequential gene activation by ecdysone. (Clever, U., 1964)
82 Autoradiographic study of protein-producing cells. (Makarov, P.V., 1965)
94 Aspects of amino acid and nucleic acid metabolism in the larva of the blowfly, Calliphora eryhrocephala. (Price, G.M., 1965)
97 Experimental activation of specific loci in polytene chromosomes of Drosophila. (Ritossa, F.M., 1964)
103 Action of ecdysone on RNA and protein metabolism in the blowfly, Calliphora erythrocephala. (Sekeris, C.E., 1965)
104 Induction of dopa-decarboxylase activity by insect messenger RNA in an in vitro amino acid incorporating system from rat liver. (Sekeris, C.E., Lang, N., 1964)
228 Giant chromosomes. (Beermann, W., 1962)
229 Hormone-controlled gene activity in the giant chromosomes of Acricotopus lucidus. (Panitz, R., 1964)
230 Salivary gland function and chromosomal puffing patterns in Drosophila hydei. (Berendes, H.D., 1965)
231 Cytological and autoradiographic studies in Sciara coprophila salivary gland chromosomes. (Gabrusewycz-Garcia, N., 1964)
232 Studies of nuclear RNA in the salivary gland of Sciara coprophila. (Gabrusewycz-Garcia, N., 1965)
233 Electron microscope autoradiography of the nucleolus of insect salivary gland cells. (Jacob, J., Sirlin, J.L., 1964)
236 Molt and intermolt activities in the epidermal cells of an insect. (Locke, M. et al., 1965
237 Incorporation of labelled thymidine into the silk gland of the silkworm. (Akai, H., Kobayashi, M., 1965)
238 Effect of the molting hormone on the synthesis of nucleic acids in the imaginal disks of Calliphora erythrocephala. (Berreur, P., 1965)
239 Autoradiographic investigations on the function of the egg follicles and the nurse cells during yolk formation and protein synthesis in the fly ovary. (Bier, K., 1963)
241 Mitotic activity in the hemocytes of Oncopeltus fasciatus (Dall). (Feir, D., O'Connor, G.M., Jr., 1965)
520 Cell stages refractory to thymidine incorporation induced by x-rays. (McGrath, R.A. et al., 1965)
522 Effects of radiation on the synthesis of nucleic acids in polytene chromosomes. (Pavan, C., Basile, R., 1963)
523 Localization of DNA complementary to ribosomal RNA in the nucleolus organizer region of Drosophila melanogaster. (Ritossa, F.M., Spiegelman, S., 1965)
568 Drosophila Cytology and genetics. (Oak Ridge National Laboratory, 1964)

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6. Lipids and Fatty Acids. Sterol and Steroid Metabolism

183 Bergmann, E.D. INSECT STEROIDS. Bull. Soc. Chim. France 10 (1965) 2787-91. (In French)

A review with 65 references.

184 Bloch, K. BIOSYNTHESIS OF CHOLESTEROL. Angew. Chem. 77, 21 (1965) 944-54. (In German)

185 Clayton, R.B. BIOSYNTHESIS OF STEROLS, STEROIDS, AND TERPENOIDS. I. BIOGENESIS OF CHOLESTEROL AND THE FUNDAMENTAL STEPS IN TERPENOID BIOSYNTHESIS. Q. Rev., Lond. 19, 2 (1965) 168-200.

A review with 156 references. Extensive use of radioisotopes is reported. (The work done on insects is not emphasized.) The article deals with the major features of the pathway of cholesterol biosynthesis, intermediate reactions between acetate and squalene, the conversion of acetate into mevalonate, and in turn into isopentenyl pyrophosphate, farnesyl pyrophosphate, and squalene, and the stereochemistry of squalene biosynthesis. The biological conversion of squalene into lanosterol, and of lanosterol into cholesterol, and the final steps in cholesterol biosynthesis are discussed.

186 Chino, H., Gilbert, L.I. LIPID RELEASE AND TRANSPORT IN INSECTS. Biochim. biophys. Acta 98 (1965) 94-110.

When isolated fat body of the silkmoth, cockroach or grasshopper was incubated with [carboxy-^{14}C]palmitate, the ^{14}C-labelled fatty acid was rapidly incorporated into the neutral lipids of the fat body. When this "prelabelled fat body" was reincubated with insect haemolymph, a rapid release of ^{14}C-labelled diglyceride took place from the fat body into the haemolymph, whereas no significant release of triglyceride occurred. This diglyceride release was specific for insect haemolymph. No significant release of diglyceride occurred into a solution of bovine serum albumin, egg albumin or rat plasma. In contrast, free fatty acid was released not only into the insect haemolymph but also into synthetic media. Diglyceride release was markedly inhibited by cyanide, 2,4-dinitrophenol and azide, whereas the release of free fatty acid was accelerated by these chemicals. The greatest rate of release of diglyceride was observed from adult silkmoth fat body, and the lowest from diapausing pupal fat body. Electrophoretic analysis of the haemolymph showed that the diglyceride released into the haemolymph was complexed to one of the haemolymph proteins. This diglyceride-protein complex seems to be the most likely form by which long-chain fatty acids are transported in the insects studied. (Auth.)

187 Clayton, R.B. THE UTILIZATION OF STEROLS BY INSECTS. J. Lipid Res. 5, 1 (1964) 3-19.

The review is divided into nutritional studies (quantitative requirements; utilization of sterols other than cholesterol; saturated sterols; sparing of the dietary requirement for cholesterol by other sterols; sterol and analogues), metabolic studies (sterol biosynthesis in insects; intestinal absorption of sterols; distribution of sterols in insect tissues; sterol ester formation), transformations of the sterol molecule (excretion of sterols and sterol metabolites; cholesterol as a precursor of an insect hormone, ecdysone and brain hormone being discussed; desaturation of the sterol nucleus; metabolism of phytosterols), the functions of sterols in insects, and some comparative aspects.

188 Gilby, A.R. LIPIDS AND THEIR METABOLISM IN INSECTS. A. Rev. Ent. 10 (1965) 141-60.

Review article. Mention is made of radioisotopes used in studies on the mechanism of sterol metabolism (p. 150) and on the biosynthesis of lipids (fatty acids and triglycerides: p. 151-2; phospholipids: p. 152; sterols and isoprenoids, and other aliphatic compounds: p. 153). An extensive bibliography (160 references) contains numerous references to radioisotope studies.

189 Agarwal, H.C., Houx, N.W.H. γ-BUTYROBETAINE DERIVATIVE IN PHOSPHOLIPIDS OF Phormia. Biochim. biophys. Acta 84, 3 (1964) 353-5.

Larvae of the blowfly, P. regina, were fed diets containing γ-butyrobetaine-methyl-^{14}C and lacking choline or carnitine. Phospholipids were fractionated chromatographically and assayed for P, radioactivity, and nature of phospholipid. The results indicated that during post-embryonic development of P. regina, no carnitine was incorporated into the phospholipids. They also provided definite proof that β-methylcholine, incorporated into the phospholipids, was derived from γ-butyrobetaine in the larval diet. (CA 61: 1964, 6088h)

190 Bade, M. L. BIOSYNTHESIS OF FATTY ACIDS IN THE ROACH Eurycotis floridana. J. Insect Physiol. 10, 2 (1964) 333-41.

After ingestion of [1-^{14}C] acetate, fatty acids of the roach, E. floridana show a labelling pattern consistent with biosynthesis by condensation of C_2 units. Oleic acid is efficiently synthesized by direct conversion of stearic acid. Synthesis of a C_{18} dienoic acid may occur at a very low rate. Oleic acid constitutes about half of the total fatty acid content, and palmitic is the most abundant saturated acid. There is only a trace of fatty acids of chain length greater than C_{18}; arachidonic acid is entirely absent. (Auth.)

191 Bridges, R. G., Ricketts, J. INCORPORATION OF N-METHYLAMINOETHANOL AND N-DIMETHYLAMINOETHANOL INTO THE PHOSPHOLIPIDS OF THE HOUSEFLY, Musca domestica. Biochem. J. 95, 3 (1965) 41P.

In the present experiments, larvae allowed to develop on a medium containing no added choline grew more slowly than when choline was present. The phospholipids of such larvae contained little phosphatidylcholine (1-2% of total lipid phosphorus compared with 14-18% found in larvae fed on a choline-containing medium) and the phosphatidylethanolamine content increased correspondingly. Larvae fed on diets containing MAE or DMAE in place of choline contained an amount of phosphatidylcholine similar to that found in larvae grown in the absence of choline. Also, when larvae were fed on a choline-free medium to which [$^{14}C_3$]L-serine had been added, no significant amount of ^{14}C-radioactivity was associated with the lipid-bound choline although labelling of ethanolamine had occurred. These findings suggest that house fly larvae are unable to synthesize choline from ethanolamine in a manner similar to that which has been demonstrated in rat liver (by Bremer et al., in Biochim. biophys. Acta 43: 1960, 477). Changes in the percentage distribution of the bases incorporated into the phospholipid fraction of the larvae fed on diets containing various combinations of ethanolamine, MAE, DMAE and choline suggest that competition can occur between ethanolamine and MAE as a substrate for the enzyme system synthesizing phosphatidylethanolamine. A similar competition occurs between DMAE and choline for the enzyme system involved in lecithin synthesis. There also appears to be an inverse relationship between the amounts of phosphatidyl-MAE and phosphatidylcholine synthesized.

192 Chino, H., Gilbert, L. I. DIGLYCERIDE RELEASE FROM INSECT FAT BODY: A POSSIBLE MEANS OF LIPID TRANSPORT. Science, N. Y. 143 (1964) 359-61.

Following injection of palmitic acid-1-^{14}C (I) into Hyalophora cecropia pupae, the specific activity of neutral fat (II) in the haemolymph was > 120-fold that in the fat body. Column chromatography revealed high radioactivity in diglyceride (III) and very low radioactivity in the triglycerides (IV). Incorporation of I into isolated fat body was very rapid, 80% of labelled II being III, although 98% of total II was IV. The specific activity of the III was almost 200-fold higher than that of the IV, suggesting that first fat body incorporates I into III then releases most of III into haemolymph. A 1.5 g fat body was incubated with I, rinsed free of I, and incubated with cell-free haemolymph. A chromatography of the neutral fat extract of haemolymph revealed rapid release of labelled III but not of labelled IV. Since a sterol (V) emerges from the column between III and IV, contaminating V was precipitated from the III fractions as the digitonide. All radioactivity remained with III. Radioassay of the eluate of a thinlayer chromatogram of the supernate showed almost all activity in a spot of mobility identical to known as well as synthetic dipalmitin-^{14}C. Following saponification of the supernate, its chromatographic mobility and almost all radioactivity corresponded to I. Identical experiments with cecropia adults give similar results except that III release was much greater. Also, in Melanoplus differentialis, II is released as III. By polyacrylamide-gel electrophoresis of haemolymph, at least two distinct proteins of cecropia pupae were found to be lipoproteins. It was demonstrated, following EtOH-Et_2O release of the lipid moiety from the lipoprotein bands, that a major portion of labelled III in haemolymph was in these bands. (CA 60: 1964, 11104c)

193(2) Clayton, R. B., Edwards, A. M. A NOVEL BIOLOGICAL DESATURATION OF THE STEROID NUCLEUS: CONVERSION OF CHOLESTANOL TO Δ^7-CHOLESTENOL IN COCKROACHES. Fedn Proc. Fedn Am. Socs exp. Biol. 21 (1962) 297. Abstr. 217.

Two species of roaches, Eurycotis floridana and Blattella germanica, were reared aseptically on synthetic diets containing 0.1% 7a-H^3-cholestanol and 0.005% 4-^{14}C cholesterol. At maturity approximately 45% of the total ^{3}H content of the tissues was found to be present in Δ^7-cholestenol. A number of different tissues contained ^{3}H-Δ^7-cholestenol in about the same concentration. The identity of the ^{3}H-Δ^7-cholestenol was revealed by gas-liquid chromatography of the sterol methyl ethers and was confirmed by hydrogenation which converted it to cholestanol under acidic conditions with a platinum catalyst but left it unchanged under neutral conditions in the presence of Raney Nickel. Contrary to the findings of other workers, using non-sterile roaches, no conversion of ^{14}C-cholesterol to any other 3-hydroxy sterol could be demonstrated in these experiments. (Abstr.)

194 Clayton, R. B. THE UTILIZATION OF STEROLS IN INSECTS: A NOVEL APPROACH TO THE STUDY OF CELL-MEMBRANE STRUCTURE. Biochem. J. 96, 2 (1965) 17P.

Quantitative data support the view that the three sterols: cholesterol, cholestanol and Δ^7-cholestanol, can be considered as tracers for three types of functional spaces of different structural specificity which occur in different combinations in the different tissues of the inserct. The subcellular distribution of these sterols was therefore studied in order to determine whether the different subcellular fractions showed different or similar patterns of incorporation. Muscle, fat, salivary gland, nerve and midgut tissues were dissected from the insect, homogenized with 0.32M-sucrose and fractionated by differential centrifugation to yield nuclear, mitochondrial, microsomal and supernatant fractions. In all cases the adequacy of the fractionation was confirmed by analyses of the fractions for DNA, RNA, succinic dehydrogenase and protein. The lipid extracts of the fractions were chromatographed on alumina to separate non-esterified sterols from the sterol ester and these were assayed for ^{14}C and ^{3}H. The same ratio ^{14}C:^{3}H was found to be present in the free sterol fraction of all subcellular particulate components of each individual tissue, though different ratios were found in different tissues. The ratios of the individual sterols or all the various particulate fractions, were essentially constant within any one tissue, but varied considerably from one tissue to another. The results are consistent with the incorporation of the sterols into a repeating unit of membrane structure which is common to all of the subcellular membrane systems of a particular tissue or cell type, but is different in different tissues.

195(2) Clayton, R. B., Edwards, A. M. CONVERSION OF 5α-CHOLESTAN-3β-OL TO Δ^7-5α-CHOLESTEN-3β-OL IN COCKROACHES. J. biol. Chem. 238 (1963) 1966-72.

In the course of the isolation and analysis of sterols the following substances were used in studies on Eurycotis floridana and Blattella germanica: cholestanol-7α-^{3}H, cholestanol-7β-^{3}H, cholestanol-4-^{14}C, cholestanol-4-^{14}C-7β-^{3}H, cholesterol-4-^{14}C, cholesterol-7α-^{3}H, cholesterol-7β-^{3}H, Δ^7-cholestenol-4-^{14}C, 5α-cholestane-3β, 7α-diol-7β-^{3}H, and 5α-cholestane-3β, 7β-diol-7α-^{3}H. The conversion of cholestanol to Δ^7-cholestenol was demonstrated. The transformation involves the loss of the 7β- and 8β-hydrogen atoms. The 3β, 7α- and 3β, 7β-dihydroxycholestanes do not behave as intermediates in the process. The conversion takes place slowly and apparently irreversibly in the intact animal and results in the distribution of the Δ^7-stenol in comparable concentrations throughout the body tissues. This desaturation is discussed in the light of present knowledge of other biological desaturations of the steroid nucleus, and some observations concerning its probable site of occurrence in the insect and its possible physiological significance are briefly considered.

196 Clayton, R. B., Lasser, N. L. THE INTRACELLULAR DISTRIBUTION OF STEROLS IN THE TISSUES OF THE COCKROACH, Eurycotis floridana. Fedn Proc. Fedn Am. Socs exp. Biol. 23, 2, Pt. I (1964) 275. Abstr. 1045. Presented at the "48th Annual Meeting, Chicago, 12-17 Apr. 1964".

The roach, E. floridana, was reared on a diet containing minimal cholesterol-^{14}C (0.005%) and cholestanol-7α-^{3}H (0.1%). Various tissues of the insects were separated by differential centrifugation into nuclear, mitochondrial, microsomal and soluble fractions. The distribution of ^{14}C and ^{3}H in esterified and non-esterified sterols and more polar steroids, between the various subcellular fractions was determined. The distribution of ^{3}H between cholestanol and Δ^7-cholestenol (a metabolite of cholestanol) was also determined. Most of the free sterol was found in the particulate cell fractions, and the ratios of the different free sterols were closely similar in both mitochondria and microsomes of a given tissue, though they were different for different tissues. The results are consistent with the incorporation of the non-esterified sterols into a repeating unit of membrane structure common to mitochondria, endoplasmic reticulum and cell membranes of a given tissue. (Abstr.)

197 Crone, H. D. PHOSPHOLIPID COMPOSITION OF FLIGHT MUSCLE SARCOSOMES FROM THE HOUSEFLY, Musca domestica. J. Insect Physiol. 10, 3 (1964) 499-507.

The title sarcosomes (flight muscle mitochondria) were examined for lipid (I) and phospholipid (II) content. The proportions of various compounds (expressed as P as % of total I P) were phosphatidylethanolamine (III) 69, phosphatidylcholine (IV) 9, polyglycerolphosphatide (V) 6, and alkali-stable II 3%. Data are tabulated on the IV and V content of the head, thorax, and abdomen, as well as the distribution of IV and V between different thorax fractions obtained in the isolation of the sarcosomes. Most of the V of the flies occurred in the thorax. The most distinctive feature of sarcosome II composition was the low proportion of IV compared with the results for the whole body. This result was of particular interest for the flies in which the proportion of IV to III in the whole body was much reduced in comparison with the proportion found in mammalian extracts. The P of IV in the sarcosomes attained a higher specific activity than that of the III when sarcosomes were isolated 24 h after injecting ^{32}P as inorganic phosphate. The difference was considerably more marked than that found in similarly treated whole flies given ^{32}P in the larval stage, with sarcosomes isolated 8 d after emergence. The proportion of IV in sarcosomes appeared to be dependent on the diet. A dietary supply of choline increased this proportion in whole adult flied, but milk feeding had no similar effect. (CA 61: 1964, 6091g)

198 Domroese, K. A. SOME ASPECTS OF LIPID CATABOLISM IN SATURNIID MOTHS. Diss. Abstr. 25, 1 (1964) 706.

The role of lipid as an energy source in adult development and flight muscle metabolism in the giant American silkworm, Hyalophora cecropia L., was investigated. Extraction of lipid and carbohydrate and oxidation of ^{14}C-labelled substrates shows that lipid is the available substrate as well as the preferred substrate in male flight muscle metabolism. Flight muscle homogenates show greater oxidative activity with fatty acids and citric acid cycle intermediates than with glucose and glycolytic intermediates. This suggests that carbohydrate pathways are not prominent in flight muscle. The intense utilization of lipid as the fuel of flight in Cecropia moths does not involve specialized metabolic pathways but proceeds along pathways commonly found in fatty acid oxidation in other organisms. It appears however, that Cecropia flight muscle differs from that of other insects in that carbodydrate pathways are not prominent.

199 Domroese, K. A., Gilbert, L. I. THE ROLE OF LIPID IN ADULT DEVELOPMENT AND FLIGHT MUSCLE METABOLISM IN Hyalophora cecropia. J. exp. Biol. 41 (1964) 573-90.

Changes in total lipid and respiratory quotient show that female pupae of H. cecropia begin to catabolize lipid early in adult development. In males there is a conservation of lipid during adult development resulting in the male moth having about three times the lipid content of the female. In the adult moth both sexes utilize lipid as the major energy source. Lipid is the available substrate as well as the preferred substrate in flight-muscle metabolism in male moths. Data on substrate preference were obtained using ^{14}C-labelled compounds. Flight-muscle homogenates show greater oxidative activity with fatty acids and citric acid cycle intermediates than with glucose or glycolytic intermediates, indicating that carbohydrate pathways are not prominent. A fatty acid oxidizing system has been identified in flight muscle which requires ATP, magnesium and a citric acid cycle intermediate for optimum activity. Experiments with radiotracers (Na-butyrate-1-^{14}C and Na-butyrate-2-^{14}C) and metabolic inhibitors reveal that fatty acid oxidation in flight muscle proceeds via the citric acid cycle and the cytochrome chain. Active fatty acid activating enzymes are present in flight muscle, and fatty acid oxidation in H. cecropia is discussed in relation to vertebrate and other invertebrate systems.

200 Earle, N. W. STEROL UTILIZATION IN THE BOLL WEEVIL. Bull. ent. Soc. Am. 10, 3 (1964) 164. Abstr.

Adult boll weevils, Anthonomus grandis Boheman, required 20 mg of cholesterol per 100 g of diet for sustained egg production and normal longevity. Without sterol in the diet, weevils laid practically no eggs and died within two weeks. Radiotracer experiments indicated a high rate of turnover of cholesterol.

201 Gilbert, L. I., Chino, H., Domroese, K. A. LIPOLYTIC ACTIVITY OF INSECT TISSUES AND ITS SIGNIFICANCE IN LIPID TRANSPORT. J. Insect Physiol. 11, 8 (1965) 1057-70.

Manometric techniques allowed the study of esterase activity in several tissues from Hyalophora cecropia and Periplaneta americana when triacetin or tributyrin were employed as substrates. These techniques were too insensitive to detect true lipase activity (hydrolysis of long-chain fatty acid glycerides). A new lipase radioassay using triolein uniformly labelled in the carboxyl position and mixed with non-radioactive carrier as substrate uncovered lipase activity in the fat body and flight muscle of the moth and in the muscle, midgut, and fat body of the cockroach. ^{14}C-diolein was obtained from emulsified triolein partially hydrolysed by incubation with pancreatic lipase. The hydrolysis of triolein and diolein by certain insect tissues was radioassayed in Tris buffer, pH 7.2 at 30°C, the substrate being actually a mixture of labelled glyceride plus unlabelled glyceride. The enzyme source was the middle layer from a centrifuged homogenate. The digestive lipase exhibited dual pH optima while a single pH optimum was found for fat body. The fact that flight-muscle lipase hydrolyses diglycerides at a rate 5 times that of triglycerides suggests that lipid transported from the fat body, in the form of protein-bound diglyceride, enters the flight muscle as diglyceride where the lipase makes the fatty acids available for sarcosomal oxidation.

202(1) Horning, M. G. p. 60C of "Meeting of the American Chemical Society, 7 Apr. 1958".

"... found that 30% of the label of cholesterol-26-^{14}C was lost by enzymic oxidation when the sterol was incubated with an acetone powder of larvae of the sawfly, Neodiprion pratti pratti, but both the physiological significance and the nature of the products of this reaction are unknown". (p. 13 of Clayton's review on the "Utilization of Sterols by Insects" in J. Lipid Res. 5: 1964, 3, ref. 187.)

203 Kaplanis, J. N., Robbins, W. E., Monroe, R. E., Shortino, T. J., Thompson, M. J. THE UTILIZATION AND FATE OF β-SITOSTEROL IN THE LARVA OF THE HOUSEFLY, Musca domestica L. J. Insect Physiol. 11 (1965) 251-8.

Using ^{3}H-β-sitosterol, gas-liquid chromatographic analysis, and a semi-defined diet with aseptic rearing techniques, it was demonstrated that larvae of the house fly, M. domestica, do not dealkylate β-sitosterol to form cholesterol. Furthermore, the major sterol (> 99%) isolated from insects reared in the above manner on a diet containing pure unlabelled β-sitosterol (100% by GLC) was identified as unchanged β-sitosterol. Beta-sitosterol, campesterol, and cholesterol were also compared in nutritional tests in which each of these three sterols served as a sole source of sterol in both the adult and larval diets. Beta-sitosterol was only approximately one-fourth as effective as either cholesterol or campesterol in supporting larval growth and development. In addition, only 1.4% of the organisms from the diet containing β-sitosterol emerged as adults and these failed to produce viable eggs. These results demonstrate conclusively that β-sitosterol is not converted to cholesterol in the house fly and that this sterol will not fulfil in entirety the sterol requirement of this insect. (Auth.)

204 Lambremont, E. N. DISTRIBUTION OF NEWLY SYNTHESIZED FATTY ACIDS TO THE PRINCIPAL LIPID FRACTIONS OF THE BOLL WEEVIL. Bull. ent. Soc. Am. 10, 3 (1964) 164. Abstr. 99.

Fatty acids newly synthesized from injected ^{14}C-1-acetate are deposited mainly in the phospholipids of unfed adults. After the adult feeds, the distribution changes somewhat, and the neutral glycerides incorporate higher amounts of labelled fatty acid. Incorporation rates appear to correlate closely with the predominating lipid fraction. (Abstr.)

205 Lambremont, E. N. BIOSYNTHESIS OF FATTY ACIDS IN ASEPTICALLY REARED INSECTS. Comp. Biochem. Physiol. 14, 3 (1965) 419-24.

Both aseptic and non-aseptic adult boll weevils (Anthonomus grandis) synthesize long-chain fatty acids from injected acetate-1-^{14}C. Equivalent synthesis rates and patterns of fatty acid labelling also were found when acetate-2-^{14}C was the precursor. Most radioactivity was in the C_{16} and C_{18} saturated and monounsaturated fatty acids. This insect synthesized some linolenic but no linoleic acid. (CA 62: 1965, 13559c)

206 Lambremont, E. N., Stein, C. I. METABOLIC INTERCONVERSIONS OF DIETARY FATTY ACIDS IN THE BOLL WEEVIL. Bull. ent. Soc. Am. 10, 3 (1964) 164. Abstr.

Boll weevils were reared in sterile larvae diet containing isotopically-labelled fatty acids. Gas chromatography and radioassay of the body fat of unfed adults indicated desaturation of stearic and palmitic to oleic and palmitoleic acids, respectively. The nutritionally important linoleic acid was not formed from either stearic or oleic acid. (Abstr.)

207 Lambremont, E.N., Stein, C.I., Bennett, A.F. SYNTHESIS AND METABOLIC CONVERSION OF FATTY ACIDS BY THE LARVAL BOLL WEEVIL. Comp. Biochem. Physiol. 16, 3 (1965) 289-302.

Larval Anthonomus grandis synthesized long-chain fatty acids from labelled NaOAc in the larval diet. Larvae, pupae, and newly moulted unfed adults had an identical labelling pattern. Oleic acid possessed 60% of the incorporated radioactivity. The weevil also desaturated dietary palmitic acid and stearic acid to palmitoleic acid and oleic acid. Some dietary palmitic acid underwent chain elongation to stearic acid which was desaturated subsequently. Dietary oleic acid was not hydrogenated. The weevil was unable to form linoleic acid from acetate and could not convert closely related long-chain fatty acids into linoleic acid. The direct desaturation pathway may be in operation on all dietary long-chain fatty acids and on fatty acids synthesized from acetate. (CA 64: 1966, 3997e)

208 Mehendale, H.M., Hodgson, E. METABOLISM OF CARNITINE IN THE BLOW FLY, Phormia regina. Bull. ent. Soc. Am. 11, 3 (1965) 159. Abstr. 100. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

Carnitine labelled with ^{14}C in either the methyl groups or the carboxyl group has been used to study the metabolism of this compound in Phormia larvae, with particular reference to the pathway leading to phosphatidyl B-methylcholine. The relation between phospholipid metabolism and dietary replacements for choline will be discussed. (Abstr.)

209 Miura, K., Vonk, H.J., Zandee, D.I., Houx, N.W.H. BIOSYNTHESIS OF UNSATURATED AND SATURATED FATTY ACIDS IN ASEPTICALLY REARED LARVAE OF Calliphora erythrocephala. Archs int. Physiol. Biochim. 73, 1 (1965) 65-72.

Synthesis of fatty acids by blue-bottle larvae was studied by addition of acetate-1-^{14}C to the food of aseptically reared specimens. Labelling of unsaturated fatty acids was twice as high as that of saturated acids. The fatty acid composition of 3-d-old larvae, determined by gas-liquid chromatography, showed the major acids to be palmitoleic (I), 39.8%, oleic (II), 34.5%, and palmitic (III), 18.3%, whereas in 7-d-old specimens the figures were II, 33.4%, III, 27.5%, and I, 26.0%; stearic was ~3% at both ages. (CA 63: 1965, 10890h)

210 Monroe, R.E. METABOLISM AND UTILIZATION OF CHOLESTEROL-4-^{14}C FOR GROWTH AND REPRODUCTION OF ASEPTICALLY-REARED HOUSE FLIES, Musca domestica L. Diss. Abstr. 25, 3 (1964) 1539.

Flies were reared on an aseptic synthetic diet containing cholesterol-4-^{14}C and the metabolism and utilization of this sterol were studied in 2-d- and 4-d-old larvae, pupae, puparia, male and female adults, eggs oviposited by flies fed a sterol-free synthetic diet, and the utilized larval media. The larvae accumulated cholesterol-4-^{14}C at a higher rate than body weight increased, indicating a strict sterol economy and larval storage of sterols. Only a trace of radiolabelled sterol was found in the puparia. The importance of sterol for sustained viable egg production was evident. The majority of the radiolabelled compounds in the larvae and pupae were free sterols, while 15.1% of the sterols in the males and 19.3% in the female flies were esterified. After eight egg collections the adults contained fewer sterol esters than at the beginning of egg laying. Free sterols proved important for embryo growth and development, while the sterol esters were probably utilized mainly in transport and storage. The free and esterified sterol fractions were mainly composed of a Δ^{5}-sterol in the larvae, pupae, and male and female flies with only a trace of $\Delta^{5,7}$-sterol in the pupae and male and female flies. However, during egg production the female flies converted nearly 16% of their cholesterol-4-^{14}C to a $\Delta^{5,7}$-sterol. The first two egg collections contained ~ 16% $\Delta^{5,7}$-sterols, collections seven and eight nearly 36% (free sterol fraction). The highest concentration in the esterified sterol fraction (27.3%) was found in collections five and six. The increased conversion of cholesterol-4-^{14}C to a $\Delta^{5,7}$-sterol during progressive egg collections would indicate that a $\Delta^{5,7}$-sterol played an important role in embryo development. Ultraviolet spectroscopy, gas-liquid chromatography employing three different liquid phases (SE-30, QF-1, and NGS), and reverse isotope dilution demonstrated that the Δ^{5}-sterol was unchanged cholesterol and the $\Delta^{5,7}$-sterol 7-dehydrocholesterol. These sterols were probably used structurally per se and as precursors for more biologically active metabolites in the house fly for growth and development and viable egg production. (From Diss. Abstr. 25: 1964, 1539)

211$^{(2)}$ Piek, T. OVER DE VORMING VAN WAS BIJ DE HONINGBIJ. (Apis mellifera L.) (Synthesis of wax in the honeybee, Apis mellifera L.). Thesis. Utrecht Rijksuniversiteit. (Netherlands). Jun. 1962, 65p. (In Dutch, with English summary)

Newly emerged bees were fed, for one or two weeks, on a sugar paste containing either heavy water, D-labelled sodium acetate, sodium acetate-1-^{14}C or uniformly labelled glucose-^{14}C. The various lipid fractions were isolated in order to investigate the origin of the components of the secreted wax. Changes in respiratory quotient as a function of age of the imagines were determined in order to ascertain the onset of wax synthesis. Following feeding with labelled acetate, isolated hydrocarbons and free wax acids were heavily labelled whereas esters and their constituent acids and alcohols were labelled lightly. Heavy water or glucose each gave the same relative labelling of the various lipid fractions of the wax. Autoradiography showed oenocytes to be 30% more radioactive than fat cells after feeding acetate-1-^{14}C. No pronounced differences were found after feeding glucose-^{14}C. It is proposed that the oenocytes synthesize wax acids and hydrocarbons from acetate originating from glycolysis in fat cells, and that the fat cells themselves synthesize the esters as well as the necessary acids and alcohols from acetate originating from the glycolysis in these cells. Oenocytes are suggested to take up acetate directly, in contrast to fat cells.

212 Piek, T. SYNTHESIS OF WAX IN THE HONEYBEE (Apis mellifera L.). J. Insect Physiol. 10, 4 (1964) 563-72.

Newly emerged honeybee workers were fed during 1 or 2 weeks with sucrose containing either heavy water, sodium acetate with deuterium, sodium acetate-1-^{14}C, or uniformly labelled glucose-^{14}C. The various lipid fractions were isolated in order to investigate the origin of the secreted wax components. In feeding acetate with deuterium or ^{14}C the isolated hydrocarbons and free wax acids were heavily labelled, but not the esters or their component acids and alcohols. Feeding uniformly labelled glucose or heavy water caused no extreme differences in the labelling of different lipid fractions. Radioactivity of the oenocytes was 30% higher than that of the fat cells (micro-autoradiographic assays) after feeding acetate-1-^{14}C, but no distinct difference was found after feeding uniformly labelled glucose-^{14}C. In order to interpret these facts the oenocytes were assumed to take up directly the acetate fed to the animals, but not so the fat cells. A proposed hypothesis supposes that oenocytes synthesize wax acids and hydrocarbons from acetate originating from the glycolysis in the fat cells, and that fat cells synthesize the esters as well as their component acids and alcohols from acetate originating from the glycolysis in these cells. (From auth.)

213 Schaefer, C.H. FATTY ACIDS OF THE VIRGINIA PINE SAWFLY, Neodiprion pratti Dyar. Can. Ent. 97, 9 (1965) 941-4.

The incorporation into fatty acids of uniformly labelled glucose (12.0 mCi/mM), [1-^{14}C]sodium acetate (11.4 mCi/mM) and [2-^{14}C] mevalonate (1.37 mCi/mM), injected into 4th- and 5th-instar larvae, is tabulated (Table 3). Glucose incorporation was relatively low, [1-^{14}C] acetate relatively high. Most of the radioactivity incorporated into the total lipids from [2-^{14}C] mevalonate was lost after saponification. Lipids account for approx. 8% of the wet weight of N. pratti larvae. Fatty acids comprise 80% of the total lipids. Approximately 75% of the fatty acids are unsaturated and > 70% have 18 carbons. Four unknowns were characterized as being polyunsaturates of 16 and 18 carbons.

214 Schaefer, C.H., Kaplanis, J.N., Robbins, W.E. THE RELATIONSHIP OF THE STEROLS OF THE VIRGINIA PINE SAWFLY, Neodiprion pratti Dyar, TO THOSE OF TWO HOST PLANTS, Pinus virginiana Mill AND Pinus rigida Mill. J. Insect Physiol. 11, 7 (1965) 1013-21.

Approximately 0.1% of the wet weight of N. pratti larvae is composed of sterols of which 73% is cholesterol, 6% is 7-dehydrocholesterol, 4% is campesterol, and 17% β-sitosterol. The sterol composition of the foliage of two host plants was as follows: P. virginiana -- β-sitosterol (92%), campesterol (7%), and 'cholesterol' (< 1%), and P. rigida -- β-sitosterol (94%) and campesterol (6%). The following ^{14}C-substrates were injected: 1-^{14}C-sodium acetate (122 050 cpm/μg), 2-^{14}C-mevalonic acid-N,N'-dibenzylethylenediamine salt (5000 cpm/μg based on free mevalonic acid), and ^{14}C-uniformly labelled glucose (114 700 cpm/μg). No larval biosynthesis of sterols from these substrates was apparent. The dealkylation of ^{3}H-β-sitosterol to ^{3}H-cholesterol by sawfly larvae was studied. Data of a gas-liquid chromatographic analysis of ^{3}H-sterols from flies fed ^{3}H-β-sitosterol and results of an analysis of the ^{3}H-sterols from sawflies by reverse isotope dilution with authentic cholesterol and purification through dibromide recrystallization are tabulated (Table III and IV). The sawfly dealkylates the phytosterols to cholesterol and presumably obtains its required cholesteral in this manner.

215 Sridhara, S., Bhat, J.V. INCORPORATION OF [1-^{14}C] ACETATE INTO THE LIPIDS OF THE SILKWORM Bombyx mori L. Biochem. J. 91, 1 (1964) 120-3.

Silkworm larvae and pupae have been shown to incorporate ^{14}C into lipid at a high rate after the injection or ingestion of [1-^{14}C] acetate. The saponifiable fraction of the lipid recovered from the insect contained two or more times the radioactivity of the unsaponifiable fraction. The sterol fraction did not contain any radioactivity. Most of the radioactivity in the saponifiable fraction was present in palmitic acid, stearic acid and oleic acid, and the polyunsaturated acids were non-radioactive. The amount of radioactivity incorporated was higher in the male than in the female pupae. (Auth. summary)

216 Sridhara, S., Bhat, J.V. FURTHER INVESTIGATIONS OF THE INCORPORATION OF [1-^{14}C]ACETATE INTO THE LIPIDS OF THE SILKWORM Bombyx mori L. Biochem. J. 94, 3 (1965) 700-4.

After the injection of sodium [1-^{14}C]acetate, the highest incorporation of ^{14}C into the lipids of the silkworm was observed after 24 h. The specific radioactivity of the palmitic acid fraction was greater and increased more rapidly than that of the stearic acid fraction, which was consistent with the precursor-product relationship to be expected on the basis of current concepts of fatty acid synthesis in vivo. The results indicate the probability of synthesis of lipid components in tissues other than the fat body. Fractionation studies indicate considerable differences in the rate of incorporation of [1-^{14}C]acetate into neutral lipids and phospholipids between larvae and pupae as well as among tissues of larvae. The rate of incorporation of [1-^{14}C] acetate remains constant throughout pupal development. (Auth.)

217 Sridhara, S., Bhat, J.V. INCORPORATION OF MEVALONATE-2-^{14}C INTO THE LIPIDS OF THE SILKWORM Bombyx mori. Life Sci. 4, 2 (1965) 167-71.

After administration of mevalonic-2-^{14}C acid to silkworms, maximum incorporation of radioactivity into lipids was 11.8% which occurred at 4 h. Approximately 47% of lipid radioactivity was in a saponified fraction and 3% was unsaponified. Approximately 75% of the ^{14}C in the saponified fraction could be identified as palmitic, stearic, and oleic acids, while 80-90% of the ^{14}C in the unsaponified fraction was isolated as hydrocarbons (10-11%), ubiquinone (14-17%), ubichromenol (20-22%), sterols (3-4%), and highly unsaturated alcohols (34-40%). (CA 62:1965, 15129c)

218 Svoboda, J.A. DEALKYLATION OF H^{3}-γ-SITOSTEROL IN AMERICAN COCKROACHES AND TOBACCO HORNWORMS. Bull. ent. Soc. Am. 11, 3 (1965) 159. Abstr. 97. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

The metabolism of ^{3}H-β-sitosterol in the American cockroach and tobacco hornworm was investigated. The free and ester sterol fractions in certain tissues and organs were examined for the presence of ^{3}H-β-sitosterol and its dealkylation product (^{3}H-cholesterol) in an attempt to define the sites and possible transport routes involved in dealkylation. (Abstr.)

219 Taylor, J.F., Hodgson, E. THE ORIGIN OF PHOSPHOLIPID ETHANOLAMINE IN THE BLOWFLY, Phormia regina (Meig.). J. Insect Physiol. 11 (1965) 281-5.

The predominant phospholipids of P. regina are those containing ethanolamine. The origin of this ethanolamine has been investigated by feeding possible precursors labelled with ^{14}C to larvae raised under axenic conditions on a chemically defined diet free of ethanolamine or serine. The phospholipids were extracted, chromatographed on silicic acid columns, and the nature of the radioactive fragments in acid hydrolysates determined. ^{14}C-labelled ethanolamine was isolated from the phospholipids of larvae raised on media containing 15.0 μCi 1,3-^{14}C-ethanolamine, 4.8 μCi uniform-^{14}C-serine; 4.8 μCi uniform-^{14}C-glycine; or 30 μCi labelled sodium formate.

220(2) Tietz, A. FAT SYNTHESIS IN CELL-FREE PREPARATIONS OF LOCUST FAT-BODY. p. 85-89 of "Biosynthesis of Lipids. Proceedings of the 5th International Congress of Biochemistry, Moscow, 10-16 Aug. 1961, Vol. 7". Popják, G., Ed. Oxford, Pergamon Press. 1963.

Fat-body tissue from ♂ and ♀ migratory locust, Locusta migratoria, (7-14 d after last moult) were used as tissue homogenates. They were able to synthesize fatty acids from ^{14}C-acetate when supplemented with ATP, $MgCl_2$, glutathione, $KHCO_3$ and malonate. Addition of CoA (coenzyme A) and TPN (triphosphopyridine nucleotides) further stimulated synthesis. Malonate could not be replaced by any intermediate of the glycolytic or Krebs cycle. However, the addition of some of these intermediates in the presence of malonate caused further stimulation. The best results were obtained with α-ketoglutarate. Tabulated data are presented on the components required for fatty acid synthesis (Table I), on the composition of glyceride-fatty acids (Table II), and on the metabolism of acetate-1-^{14}C and of malonate-1-^{14}C studied in the homogenate, supernatant, and particles (Table III).

221 Vroman, H.E., Kaplanis, J.N., Robbins, W.E. EFFECT OF ALLATECTOMY ON LIPID BIOSYNTHESIS AND TURNOVER IN THE FEMALE AMERICAN COCKROACH, Periplaneta americana (L.) J. Insect Physiol. 11, 7 (1965) 897-904.

The control of the corpora allata over lipid biosynthesis and turnover was studied in the American cockroach, P. americana (L.), by using 1-^{14}C-acetate as a precursor. The labelled acetate was injected into allatectomized and control roaches and the time-curve of the appearance of label in lipid fractions was determined. It was found that the greatest effect was in the triglyceride fraction, which was more than twice as much per roach in the operated insects, whereas no obvious effect was noted on the hydrocarbon fraction. Allatectomy noticeably slowed the turnover of both triglyceride and phospholipids. (Auth.)

222 Vroman, H.E., Kaplanis, J.N., Robbins, W.E. CHOLESTEROL TURNOVER IN THE AMERICAN COCKROACH, Periplaneta americana. J. Lipid Res. 5, 3 (1964) 418-21.

Turnover of cholesterol (I) in P. americana is slow relative to that in mammals, as determined by feeding I-4-^{14}C in the diet. At least 40% of carcass I is exchangeable with dietary I. (CA 61:1964, 7422g)

223(2) Weaver, N., Law, J.H. HETEROGENEITY OF FATTY ACIDS FROM ROYAL JELLY. Nature, Lond. 188 (1960) 938-9.

Sodium acetate-1-^{14}C and sodium stearate-1-^{14}C were fed to worker bees and also included in an incubation medium with excised mandibular glands. In both cases considerable radioactivity was detected in lipid extracts of the mandibular glands, but the hydroxy fatty acid fraction did not become labelled.

224 Wiens, A.W., Gilbert, L.I. REGULATION OF COCKROACH FAT-BODY METABOLISM BY THE CORPUS CARDIACUM IN VITRO. Science, N.Y. 150 (1965) 615-6.

Incubation in vitro of young, adult, male Leucophaea maderae fat body with extracts of corpora cardiaca or intact corpora cardiaca results in stimulation of oxygen consumption but reduction in CO_2 evolved from carbohydrate. The $^{14}CO_2$ resulting from the oxidation of uniformly labelled glucose-^{14}C was only about 70% of the controls. In the experiments on oxidation, the incubation medium contained 3 ml of Ringer solution and 2×10^6 cpm of sodium acetate-1-^{14}C or sodium palmitate-1-^{14}C. The carbohydrate is preferentially used for trehalose synthesis, and the endogenous metabolism of the fat body appears to be supported by increased lipid utilization. A hormone from the corpus cardiacum is most likely responsible for these effects and may act at two points, at least, in the glycolytic pathway.

See also:

43-a Biosynthesis of royal jelly fatty acid from sucrose. (Brown, W.H. et al., 1962)
46 Studies on the interconversion of carbohydrate and fatty acid in Hyalophora cecropia. (Chino, H., Gilbert, L.I., 1965)
48 The metabolism of glucose and its conversion into long-chain fatty acids by the boll weevil. (Lambremont, E.N., 1965)
51 Interconversion of carbohydrate and fat in the silkworm Bombyx mori L. (Sridhara, S., Bhat, J.V., 1965)
80 The chemistry and physiology of the brain hormone. (Kobayashi, M., 1963)

136 Meetings. Insect biochemistry. (Levenbook, L., 1965)
246 Intermediary metabolism and the insect fat body. (Kilby, B.A., 1965)
261 C^{14}O$_2$ production in the boll weevil, Anthonomus grandis, after injection of ^{14}C-1-acetate. (Lambremont, E. N., Stein, C.I., 1965)

7. Organic Acids

225 Brenner-Holzach, O., Leuthardt, F. ORIGIN OF THE C-2 AND C-8 ATOMS IN URIC ACID IN Drosophila melanogaster. Helv. chim. Acta 48, 5 (1965) 1147-51. (In German)

When D. melanogaster were fed with glucose-1-^{14}C and glucose-6-^{14}C, more ^{14}C was incorporated in C-2 and C-8 of uric acid from glucose-6-^{14}C. The ^{14}C from serine-3-^{14}C was also incorporated into C-2 and C-8 of uric acid. In homogenates of Drosophila larvae, more ^{14}CO$_2$ came from glucose-1-^{14}C than from glucose-6-^{14}C. Thus, glucose was oxidized by glycolytic and glucose phosphate shunt pathways in Drosophila. Most of the active formate used to synthesize purines was derived from C-3 of serine. (CA 63: 1965,8783f)

226 Corrigan, J.J. STUDIES IN D-SERINE AND D-2, 3-DIAMINIPROPIONIC ACID IN Bombyx mori. Bull. ent. Soc. Am. 11, 3(1965) 159. Abstr. 93. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

The origin of D-2, 3-diaminipropionic acid (DAPA) in gastro-intestinal fluid of Bombyx larvae and its possible relationship to D-serine, were investigated. Glucose-^{14}C was incorporated by larvae into a compound with properties of D-DAPA. That tent caterpillars lack both D-serine and DAPA may be pertinent. (Abstr.)

227 Hitchcock, M., Smith, J.N. COMPARATIVE DETOXICATION. XIII. DETOXICATION OF AROMATIC ACIDS IN ARACHNIDS: ARGININE, GLUTAMIC ACID, AND GLUTAMINE CONJUGATIONS. Biochem. J. 93, 2 (1964) 392-400.

Conjugation of p-nitrobenzoic acid, p-aminobenzoic acid, and benzoic acid-^{14}C has been studied in representatives of three arachnid orders. N^2-Aroylarginines were formed in each species. In Boophilus, Tegenaria, Agelena, and Epeira aroylglutamic acids were also found. In Tegenaria, Epeira, Agelena, Mitopus, and Phalangium, N^2-aroylglutamines were found. (CA 61: 1964, 13669c)

8. Antimetabolites

See:

134 Some factors influencing the utilization of tritiated thymidine in grasshopper embryos. (Leach, W.M., 1965)

9. Cell. Tissue. Organ

228(2) Beermann, W. RIESENCHROMOSOMEN. (Giant chromosomes). Protoplasmatologia 6 (1962) 1-161. (In German)

Review.

229 Panitz, R. HORMONKONTROLLIERTE GENAKTIVITÄTEN IN DEN RIESENCHROMOSOMEN VON Acricotopus lucidus. (Hormone-controlled gene activity in the giant chromosomes of Acricotopus lucidus). Biol. Zbl. 83 (1964) 197-230. (In German, with English summary)

In each lobe of the tripartite midge salivary gland, the chromosomes show a characteristic pattern of puffs. Numerous studies are cited throughout in which radioisotopes had been used to study puffs and puff formation. In the anterior lobe, Balbiani rings at loci BR-3 and BR-4 regress during the prepupal stage. Experiments have been performed to determine the cause of temporal variation. Transplantation from the larva into the prepupa of Acricotopus or other Diptera inactivate the two puffs as does cultivation in prepupal haemolymph or in larval haemolymph to which pupal brain complex has been added. There is no effect upon transplantation into other larvae or larval haemolymph. The inactivating factor seems to originate from a part of the ring gland responsible for the production of ecdysome. Temperature as well as hormone concentration influences the process. Loci I/H-18 and II/Q-32 also undergo alterations in similar experiments.

230 Berendes, H.D. SALIVARY GLAND FUNCTION AND CHROMOSOMAL PUFFING PATTERNS IN Drosophila hydei. Chromosoma 17, 1 (1965) 35-77.

The relation between a specific cell function and the puffing pattern was studied in the salivary gland of D. hydei, which shows two different types of cell during the late 3rd instar. An attempt was made to elucidate the factors which might be involved in the differentiation of these two types of cell and the changes in activity or regulation of the puffs involved. The first signs of these differences first appear as an increase in the cellular and nuclear volume in the distal cells of the gland, starting at 103 h after oviposition. Subsequent changes and probable secretory function are described. Determination of nuclear diameter and DNA in nuclei of both parts of the gland revealed a correlation between a particular DNA content and the function of the cell. Distal cells show higher nuclear diameters than proximal cells after the onset of granule production. The first differences in nuclear diameter can be seen at 103 h. The total puffing pattern during late larval and early pupal development was studied, details of the techniques being given (light-, phase- and electron microscopy were used). Puffing patterns were determined at several time intervals during the 3rd instar, prepupal and early pupal stages. Puff activities were determined by comparing the diameter of the puffed regions with that of the neighbouring non-puffed regions. A total number of 148 puffs were present during some period of the 3rd instar, prepupal, and early pupal stages. The activity of 110 puffs was evaluated during a series of successive time intervals. Changes in the puffing pattern during puparium formation were compared with those observed during pupation. Proximal and distal nuclei differ in the activity level of a number of puffs, but only puff 47 B is restricted in activity to the distal cells. This puff becomes active at 119 h and disappears 4 h before puparium formation (156 h). For autoradiography, dissected glands were incubated for 30 min in a Ringer solution containing 10 μCi/ml ^{3}H-uridine (specific activity 1.29 Ci/mM). An exposure time of 3 weeks was required.

231 Gabrusewycz-Garcia, N. CYTOLOGICAL AND AUTORADIOGRAPHIC STUDIES IN Sciara coprophila SALIVARY GLAND CHROMOSOMES. Chromosoma 15, 3 (1964) 312-44.

Morphological and metabolic changes on the salivary chromosomes of S. coprophila were followed during the later half of the 4th larval instar. Cytological maps were prepared for five successive stages from mid 4th instar to the prepupal stage, which summarized the cytological findings and were the basis for studies on DNA replication of these chromosomes. In the autoradiographic experiments use was made of ^{3}H-thymidine as DNA precursor. Marked differences in the relative rates of uptake of ^{3}H-thymidine of a number of bands in a certain proportion of chromosomes were observed, while others with uniform incorporation were found more frequently. The period of uniform labelling must therefore comprise a greater part of the replication cycle than the periods of localized labelling. To assess the validity and constancy of the observed patterns of unequal incorporation, a semi-quantitative analysis was carried out. It showed that the bands with localized uptake may be separated into two broad groups, one of them containing the centromere regions and certain chromosomal ends, which are presumably heterochromatic, the other most of the puff sites and bulbs. Since late replication is characteristic of heterochromatin, bands of the first group (C) were assumed to replicate late in the cycle, puffs and bulbs to start early, and the period of equal labelling to be intermediate. Other intermediate labelling patterns were observed and are described. It is known that in the 4th instar from two to three DNA replications occur in the salivary gland nuclei, the last of which coincides with puffing. Several stages may be distinguished in the puffing process based on morphology and rates of isotope uptake of the puffs. The first sign of puffing is a very high rate of incorporation at puffs. It is maintained throughout this last period of DNA synthesis and only declines when all other chromosomal regions have ceased to replicate. A pattern of high and exclusive uptake at the heterochromatic sites (pattern C) was never observed in this replication: instead puffs are the last regions to terminate DNA synthesis. The results are discussed in relation to asynchronous DNA replication, the problem of "metabolic DNA", and the concept of the heterochromatic state.

232 Gabrusewycz-Garcia, N. STUDIES OF NUCLEAR RNA IN THE SALIVARY GLAND OF *Sciara coprophila*. *J. Cell. Biol.* *27*, 2 (1965) 31A-32A. Abstr. 58. Paper presented at the "5th Annual Meeting of the American Society for Cell Biology, 10-12 Nov. 1965, Philadelphia".

Staining techniques (azure A and toluidine blue at pH 4.0) combined with ribonuclease digestion were used, as well as autoradiography with ^{3}H-uridine. A striking characteristic of these nuclei is the extensive fluctuation in the rate of RNA synthesis in glands from different larvae. There is also variation in the proportion of extrachromosomal to puff RNA, probably related to metabolic events preceding metamorphosis. A typical nucleolar organizer is present in these nuclei, associated with a large cluster of micronucleoli. This conclusion was reached after examination of sectioned material and smear preparations of salivary, midgut, and Malpighian tubule nuclei. The nucleolar organizer was localized in the proximal heterochromatic end of the X-chromosome. In addition, a smaller number of micronucleoli of identical appearance are produced at many other bands. A careful analysis was made to localize these bands with respect to their map position. The majority were identified with the heteropycnotic regions which, from a previous study, are known to be asynchronous in their DNA replication. It was also observed that micronucleoli are produced at the DNA puffs, a fact previously known, and occasionally at bulbs. As yet we have no direct information on the functional significance and the interrelations of these different RNA-containing structures. (From abstr.)

233 Jacob, J., Sirlin, J.L. ELECTRON MICROSCOPE AUTORADIOGRAPHY OF THE NUCLEOLUS OF INSECT SALIVARY GLAND CELLS. *Nature*, Lond. *202* (1964) 622-23.

Larval salivary glands of the chironomid *Smittia* were incubated in vitro for 20-25 min in Morgan, Morton and Parker's Medium 199 supplemented with ^{3}H-uridine at 60 μCi/cc (specific activity 3.0 Ci/mM). After incubation the glands were fixed in cold 1% OsO_4 buffered with veronal acetate and embedded in methacrylate mixture. Pale gold sections were mounted on grids (Formvar on nickel), subsequently covered with Ilford L4 emulsion. After varying exposures at 4-5°C they were developed in Kodak D-19b or "Microdol-X" for 5 min at 20°C, and fixed for 10 min in acid hardening fixer (Johnson's "FIX-SOL") diluted 9 times with water. Grids were then stained for at least 1 h in a saturated solution of uranyl acetate in 50% alcohol, the gelatine being removed at that stage or earlier on. A definite autoradiographic response is obtained over the nucleolus after a 60 d exposure. The autoradiographs shown were obtained after a 90 d exposure. The organizer evidently does not contribute to any observable extent to the synthesis of nucleolar RNA in the larval salivary gland of cells of *Smittia*.

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234 Bowers, W.S., Thompson, M.J. IDENTIFICATION OF THE MAJOR CONSTITUENTS OF THE CRYSTALLINE POWDER COVERING THE LARVAL CUTICLE OF *Samia cynthia ricini* (Jones). *J. Insect Physiol.* *11*, 7 (1965) 1103-11.

A white crystalline powder was observed to accumulate superficially on the larval cuticle of *S. cynthia ricini* (Jones). Most of this powder (92.6%) was shown to be a mixture of two straight chain saturated alcohols, 99.4% *n*-triacontanol ($C_{30}H_{62}O$) and 0.6% *n*-octacosanol ($C_{28}H_{58}O$). Larval synthesis of these alcohols was demonstrated by injecting 2-d-old 5th instar larvae with 3 million counts of 1-^{14}C-sodium acetate (specific activity 23.6 × 10^{6} cpm/mg) each. Subsequent analyses are described.

235 Lipke, H., Leto, S., Graves, B. CARBOHYDRATE-AMINO ACID CONVERSIONS DURING CUTICLE SYNTHESIS IN *Periplaneta americana*. *J. Insect Physiol.* *11*, 9 (1965) 1225-32.

The administration of glucose-U-^{14}C to larvae resulted in significant incorporation of isotope into nutritionally essential amino acids in 24 h. Valine, tyrosine, phenylalanine, histidine, and threonine of cuticle and fat body protein acquired radioactivity indicating that this transformation was mediated with the aid of the intracellular symbionts. The leucines, however, originated primarily in the diet. No significant difference in the rate of synthesis of these amino acids was observed between the fourth and eighth day postmoult although some depression in symbiont activity may have occurred in the premoult stage. The specific acitivity of the glutamic acid, glycine, threonine, proline, and valine free in the blood was of the same order of magnitude as that newly incorporated in the cuticle protein. Cuticle alanine, however, exceeded plasma and fat body alanine in specific activity by a factor of three or more. Phenylalanine and tyrosine may share a common precursor rather than exist in a product-precursor relation and the same may be true of the glutamic acid-proline pair. A high rate of conversion of proline to trehalose characterized the intermoult period; serine, however, was not glycogenic in this species. In experiments with glucose-1-^{14}C and L-proline-3,4-^{3}H the radioactive compounds were injected simultaneously on the second day following moulting.

236 Locke, M. Condoulis, W.V., Hushman, L.F. MOLT AND INTERMOLT ACTIVITIES IN THE EPIDERMAL CELLS OF AN INSECT. *Science*, N.Y. *149* (1965) 437-8.

In the larva of the butterfly *Calpodes ethlius* (Lepidoptera: Hesperiidae) moult and intermoult syntheses by the epidermis were each preceded by a phase of RNA synthesis. Endocuticle deposition and the secretion of wax are controlled not only by the moulting hormone when they take place during the intermoult period. The control of endocuticle deposition was studied autoradiographically, using ^{3}H-glucose as a marker for chitin and ^{3}H-tyrosine for the protein component. RNA synthesis was studied using ^{3}H-uridine (10 μCi/g weight of *Calpodes* larva, in 0.1 ml Ringer solution).

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237 Akai, H., Kobayashi, M. INCORPORATION OF LABELLED THYMIDINE INTO THE SILK GLAND OF THE SILKWORM. *Nature*, Lond. *206* (1965) 847-8.

Electron microscopic autoradiography was used to study silk glands of *Bombyx mori* larvae (5th day after 4th moult). Silk glands were dissected out either 30 min or 2 h after injection of 50 μCi of thymidine-6-^{3}H. The technique used subsequently is described. Results indicated that in the nucleus of the silk gland DNA is synthesized on chromatin bodies and diffuse chromatins prior to the so-called endomitosis without cell division. The function of the chromatin in the nucleus of the silk gland may therefore well correspond to that of the polytene chromosome in the salivary gland of Diptera, although no chromosomes have yet been observed in the silk gland of *B. mori*.

238 Berreur, P. EFFECT OF THE MOLTING HORMONE ON THE SYNTHESIS OF NUCLEIC ACIDS IN THE IMAGINAL DISKS OF *Calliphora erythrocephala*. *C.r. hebd. Séanc. Acad. Sci.*, Paris *260*, 10 (1965) 2914-16. (In French)

The synthesis of DNA and RNA in *C. erythrocephala* was studied by a historadiographic technique applied to normal larvae and to larvae deprived of the moulting hormone by removal of the Weissmann ring. In the absence of the hormone, DNA synthesis disappeared and elaboration of RNA was considerably reduced. The re-introduction of the hormone by implantation of the Weissmann ring caused the re-appearance first of RNA synthesis in the nucleus and later the elaboration of new molecules of DNA. (CA 62: 1965, 15136f)

239(2) Bier, K. AUTORADIOGRAPHISCHE UNTERSUCHUNGEN ÜBER DIE LEISTUNGEN DES FOLLIKELEPITHELS UND DER NÄHRZELLEN BEI DER DOTTERBILDUNG UND EIWEISSYNTHESE IM FLIEGENOVAR. (Autoradiographic investigations on the function of the egg follicles and the nurse cells during yolk formation and protein synthesis in the fly ovary). *Wilhelm Roux Arch. EntwMech. Org.* *154*, 6 (1963) 552-75. (In German, with English summary)

Development of the egg-follicle in *Calliphora erythrocephala* and *Musca domestica* (similar for both) is divided into six stages. This study concentrates on stages two and three when yolk formation is already initiated while the nurse cells are still in their full functional phase. The incorporation of ^{3}H-L-histidine was followed during different incubation periods. From the shift of the maximum radioactivity from the follicle epithelium with a high turnover to the nurse cells it is concluded that the pool of the labelled amino acid is largely exhausted 1 h after injection. The radioactivity of the yolk border and spheres is ascribed to labelled proteins, which are transported into the oocyte with the help of the follicle cells. By ovary implantation in previously incubated host females the path of the yolk precursors through the intercellular spaces in the follicle epithelium up to the cortical regions of the oocyte was effectively demonstrated, without any cytoplasmic incorporation of ^{3}H-histidine. The entry of labelled protein from the nurse cells into the oocyte during stage two is questionable, and improbable during stage three. During this period, however, RNA (labelled by using ^{3}H-cytidine and ^{3}H-uridine) from the nurse cells enters the oocyte via the intercellular cytoplasmic bridges and there maintains protein synthesis. In stage four the cytoplasm of the degenerating nurse cells flows into the oocyte. The significance of the function of the nurse cells as sources of RNA and cytoplasm, which exert direct influence on ooplasmic growth and embryonic development is discussed relative to the follicle cells which gather and transport blood proteins intended for deposition in the yolk platelets.

240 Engels, W., Drescher, W. EINBAU VON H^3-D-GLUCOSE WÄHREND DER OOGENESE BEI Apis mellifica L. (Incorporation of H^3-D-glucose during oogenesis in Apis mellifica L.). Experientia 20, 8 (1964) 445-7. (In German, with English summary)

The incorporation of ^3H-glucose into the ovary of honeybee queens was studied by autoradiography. During the last stages of oogenesis, the synthesis of respectable amounts of glycogen was found in the reticulolasm of the developing eggs. The follicle epithelium and also the nurse cells only appeared more lightly and transitorily labelled at medium stages. A hypothesis was established concerning an antagonism of protein and polysaccharide formation in the cytoplasm corresponding to the rather late occurrence of glycogen in insect oogenesis. (Auth. summary).

241 Feir, D., O'Connor, G.M., Jr. MITOTIC ACTIVITY IN THE HEMOCYTES OF Oncopeltus fasciatus (Dall). Expl Cell Res. 39, 2-3 (1965) 637-42.

Milk weed bugs received 2 µl of ^3H-thymidine solution and the controls 2 µl of 0.7% saline. The tritium had a specific activity of 1.90 Ci/mM and a concentration of 0.50 mCi/ml. Each insect was injected once and bled once. The 5th instars used showed high peaks of incorporation of ^3H-thymidine into their haemocytes on 5-6 and 9-10 d after moult, regardless of the day in the fifth stadium when the injection of thymidine is given. In most groups there was considerable delay after injection before incorporation was seen in the haemocytes, and no incorporation was seen when the thymidine was administered 48 and 24 h before the adult moult. Variable percentages (0-15) of mitosis were seen throughout the stadium. There was no correlation of the mitotic index with post-moult age of the insect, day of injection, or peaks of ^3H-thymidine incorporation. Delayed incorporation in the haemocytes, sudden very high peaks of cells with incorporation, and a low level of mitotic activity in the haemocytes compared with the sudden high percentages of cells with incorporation indicate that a portion of the circulating haemocytes are formed in fixed tissue sites or organs and are released into the circulating haemolymph.

242 Hanser, G., Rembold, H. ANALYTISCHE UND HISTOLOGISCHE UNTERSUCHUNGEN DER KOPF- UND THORAXDRUSEN BEI DER HONIGBIENE Apis mellifica. (Analytical and histological study of the head and thorax glands in the honeybee Apis mellifica). Z. Naturf. 19b, 10 (1965) 938-43. (In German)

External conditions modify the biopterin and pantothenic acid contents in the mandibular glands of nurse bees. The heterocyclic compounds characteristic for royal jelly and brood food are only found in the pharyngeal glands. These findings and the histo-autoradiographic demonstration of the oriented incorporation of [2-^{14}C]biopterin imply that brood food is basic food secreted by the pharyngeal glands. Comparative histological studies show gland enlargement and an increase in the deep-seated cells of the postgenal glands in nurse bees of the royal brood. The roles played by various glands in the formation of brood food is discussed.

243 Heslop, J.P. THE ESTIMATION OF ADENOSINE TRIPHOSPHATE AND RELATED COMPOUNDS IN INSECT TISSUE. Biochem. J. 91 (1964) 183-7.

Some conditions for the successful extraction of labile phosphorus compounds from frozen house fly tissue have been investigated. Phosphorus compounds in the thorax were estimated by the labelled-pool technique. The concentration of ATP in the thorax was determined by the labelled-pool technique, adenine estimation, firefly luciferin, and phosphoglycerate kinase. Evidence is presented for the existence in insect tissues of a non-phosphorylated substance found to interfere with the estimation of ATP by two widely used assay systems.

244(2) Highnam, K.C. NEUROSECRETORY CONTROL OF OVARIAN DEVELOPMENT IN THE DESERT LOCUST. p. 370-90 of "Proceedings of the 3rd International Symposium on Neurosecretion, Bristol, England, 1961".

^{35}S-cystine was used in a comparison of the neurosecretory system in Schistocerca gregaria females reared with or without males.

245(2) Highnam, K.C. NEUROSECRETORY CONTROL OF OVARIAN DEVELOPMENT IN THE DESERT LOCUST. Mem. Soc. Endocr. 12 (1962) 370-90.

".... The rate of incorporation of ^{35}S-amino acids into the neurosecretory system (of oocytes) suggests that when small amounts of histologically visible material are present, the neurosecretory system is rapidly synthesizing and releasing developmental factors, whereas some synthesis but little release of neurosecretory factors occurs in a system where large amounts of paraldehyde fuchsin (PF)-staining material are present...." (Cited in J. Insect Physiol. 10:1964, 859).

246 Kilby, B.A. INTERMEDIARY METABOLISM AND THE INSECT FAT BODY. p. 39-48 of "Aspects of Insect Biochemistry. Biochemical Society Symposium No. 25, London, 1 Apr. 1965". Goodwin, T.W., Ed. London, Academic Press, 1965, 107p.

Some of the published work on intermediary metabolism of fat, carbohydrate, protein, and purines in fat body are reviewed; the fat body is seen to be able to synthesize fat, carbohydrates and protein from a variety of substances and store them ready for mobilization when required as a source of energy or for the building of new tissue. It is a site of much intermediary metabolism, a regulator or some blood constituents, a location for detoxification and, in some cases, of waste products and symbionts. Radioisotopes were used in a number of studies.

247 Langer, H. PHOSPHATE METABOLISM OF THE COMPOUND EYE, IN DARKNESS AND IN LIGHT. Helgoländer wiss. Meeresunters. 9, 1/4 (1964) 251-60. (In German)

The concentration of various compounds involved in the phosphate metabolism was detected in the eyes of u.v.-exposed Calliphora erythrocephala. The controls were kept in darkness. The values for phosphatides (I), nucleic acids (II), ATP, ADP, AMP, and free inorganic phosphate were 27.5, 12.3, 2.02, 0.78, 1.74, and 4.65 nanomoles/eye, respectively, in 6 h u.v.-exposed insects, and 26.7, 12.2, 2.73, 0.58, 1.97 and 3.95 nanomoles/eye, respectively, in 6 h u.v.-exposed insects, and 26.7, 12.2, 2.73, 0.58, 1.97 and 3.95 nanomoles/eye, respectively in controls. Starved C. erythrocephala flies were fed 1 µCi $^{32}PO_4^{3-}$/fly. Four h after feeding, the overall ^{32}P incorporation was 35% higher in the eyes of u.v.-exposed flies as compared with the eyes of flies kept in darkness. The rate of ^{32}P incorporation into various compounds was in the following order: acid-soluble compounds (III) ≫ phosphoproteins (IV) > II > I for u.v.-exposed flies and III ≫ IV > II > I for flies kept in darkness. (CA 62:1965, 9505d)

248 Marcuzzi, G., Degasperi, P. APPLICATION OF THE AUTORADIOGRAPHIC TECHNIQUE TO THE STUDY OF THE EXCRETION IN THE COLEOPTEROUS INSECT Tenebrio molitor L. EUR-2200e. Dec. 1964, 514p. p. 127-29 of "Preparation and Biomedical Application of Labelled Molecules. Proceedings of a Symposium, Venice, 23-29 Aug. 1964".

Penicillin-^{14}C was used in the autoradiographic study of the excretory function of malpighian tubules of the coleopterous insect T. molitor. Results indicated that penicillin is eliminated by malpighian tubules through a process of passive diffusion, perhaps reinforced by secretion when the substance is very diluted in the haemolymph. (NSA 19:1965, 31762)

249 Münchberg, P. ZUR DEMONSTRATION DER DURCHBLUTUNGSVERHÄLTNISSE DER LIBELLENFLÜGEL DURCH INJEKTIONEN VON LÖSUNGEN VON $Na_2{}^{35}SO_2$ UND $Na_2H^{32}PO_4$. (Demonstrating the haemolymph circulation in dragonfly wings by means of injections of $Na_2{}^{35}SO_2$ and $Na_2H^{32}PO_4$ solutions). Z. Naturf. 19b, 7 (1964) 634-40. (In German)

In order to follow haemolymph circulation in the wing, ^{35}S in $Na_2{}^{35}SO_4$ which is a source of soft β-rays proved preferable to the considerably higher energy available from $Na_2H^{32}PO_4$. Although ^{32}P gives pictures of good contrast some wing regions remain empty or apparently structureless due to excessive irradiation. Thoracic injections were given below the wing insertion at the meso- and metapleura; activities of 10 µCi were used in 0,5 ml solution for ^{32}P and 0,2 ml for ^{35}S, Zygoptera receiving 0,025-0,05 ml, and Anisoptera 0,05-0,1 ml. Two injections were used for large dragonflies (Aeschna and Cordulegaster). The following species were studied: Lestes sponsa Hansemann, Pyrrhosoma nymphula (Sulzer), Calopteryx virgo (L.), Sympetrum vulgatum (L.), Aeschna mixta (Latr.), and Cordulegaster boltonii (Donovan). Zones of intensive circulation of blood in Odonata were noted not only in the venation at the anterior margin of the wing but throughout the veins at the wing tips. Reasons are put forward which indicate a pulsating function of the pterostigma.

250 Oak Ridge National Lab., Tenn. CYTOLOGY AND GENETICS. p. 36-49 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1965". ORNL-3853. Nov. 1965, 222p.

Amongst other work, tracer studies of the metabolism of polytene chromosomes, spermatogenesis, and oogenesis in *Rhynchosciara angelae* (Sciaridae) are reported.

251 Taylor, J.H. THE ARRANGEMENT OF CHROMOSOMES IN THE MATURE SPERM OF THE GRASSHOPPER. *J. Cell Biol.* *21*, 2 (1964) 286-9.

In order to study the chromosome arrangement within the sperm nucleus males of the grasshopper *Romalea microptera* (Beauvoir) were injected during the last instar with 20 µCi of ^{3}H-thymidine (specific activity 1000 mCi/mM). Mature labelled sperm were obtained within 60 d under the experimental conditions described. A tandem alignment was observed, with each chromosome occupying a short segment of the elongated head. Chromosomes were found to be randomly disposed along the length of the nucleus.

252 Treherne, J.E. THE DISTRIBUTION AND EXCHANGE OF INORGANIC IONS IN THE CENTRAL NERVOUS SYSTEM OF THE STICK INSECT *Carausius morosus*. *J. exp. Biol.* *42* (1965) 7-27.

Flame photometry and radioactive tracers were used. The inulin space in the central nerve cord was made using ^{14}C-labelled inulin. ^{22}Na was used for measuring the uptake of sodium by the nerve cord in (in vivo) experiments and for measuring sodium efflux. The effect of a metabolic inhibitor, 2,4-dinitrophenol, on sodium and potassium uptake were studied using ^{22}N and ^{42}K, respectively. The efflux of calcium ions from isolated nerve cord was studied with ^{45}Ca, and ^{36}Cl was used to investigate the uptake and efflux of chloride ions. The exchanges of labelled ions showed rapid and slow components which correspond to extra- and intracellular compartments within the central nervous system. The uptake of Na from the haemolymph and its concentration in the extracellular fluid is reduced in the presence of metabolic inhibitors. The distribution between haemolymph and extracellular fluid of Ca and Mg, also of Na in poisoned preparation, conforms to a Donnan equilibrium. The distribution of K, even in poisoned preparations, does not conform and it is suggested that the acitivity of this ion may be lower than in free solution. The concentration of Mg is appreciably greater in the extracellular than in the intracellular compartment. The possible role of Mg in nervous transmission in this insect is discussed.

253 Treherne, J.E., Smith, D.S. THE PENETRATION OF ACETYLCHOLINE INTO THE CENTRAL NERVOUS TISSUES OF AN INSECT (*Periplaneta americana* L.) *J. exp. Biol.* *43* (1965) 13-21.

^{14}C-labelled acetylcholine was found to penetrate rapidly into the tissues of the intact abdominal nerve cord. Uptake in the presence of 10^{-4} M eserine occurred as a two-stage process, the initial rapid influx being identified as the penetration into the extracellular system of the nerve cord. There was a more rapid accumulation of radioactivity in normal preparations as compared with those treated with 10^{-4} M eserine, presumably as a result of intracellular uptake of the products of hydrolysis of the acetylcholine. The level of radioactivity in the rapidly exchanging fraction was consistent with the hypothesis that the acetylcholine ions were distributed in the extracellular fluid according to a Donnan equilibrium with the haemolymph in eserinized preparations. These results are discussed in relation to the possible physiological role of acetylcholine in synaptic transmission in this insect. (Auth. summary)

254 Treherne, J.E., Smith, D.S. THE METABOLISM OF ACETYLCHOLINE IN THE INTACT CENTRAL NERVOUS SYSTEM OF AN INSECT (*Periplaneta americana*). *J. exp. Biol.* *43*, 3 (1965) 441-54.

In studies to test the possibility that the cholinergic system operates in the ganglia of the cockroach, acetylcholine-^{3}H iodide (*I*) was rapidly metabolized by the intact nerve cord from the cockroach, *P. americana*, bathed in solutions containing up to 10^{-2} *M* *I*; eserine completely prevented this metabolism. Comparison of chromatograms of tissue extracts from whole nerve cords with those from a single terminal ganglia indicated that the latter preparation metabolized *I* more rapidly, due to the smaller surface/volume ratio and the higher cholinesterase content in this structure. Appreciable hydrolysis of *I* occurred at the periphery of the nerve cord, an observation which correlated well with the electron-microscopic demonstration of regions of eserine-sensitive cholinesterase on the glial membranes in the periphery of ganglia and connectives. Accumulation of some diffusible acetylcholine in the fibrous layer suggested that some hydrolysis may also occur here. The high activity of the cholinesterase system in this insect explains the relative insensitivity of the insect central nervous system to applied *I* and excludes the existence of a peripheral diffusion barrier to this substance. The higher concentrations of acetylcholine required to produce a discharge in the presence of eserine over that concentration required in vertegrates was accounted for by postulating a relatively low sensitivity of the insect subsynaptic membrane to acetylcholine; this insensitivity could be correlated with the higher order of concentration of acetylcholine in insect nervous tissue over that in vertebrate nervous tissue. (CA 64: 1966, 8687b)

See also:

37 Données biochimiques et histochimiques sur l'incorporation du sulfate de sodium radioactif, chez *Gryllus bimaculatus* de Geer (Insecte, Orthoptère). (Martoja, R., 1964)
49 Polysaccharide and glycoprotein formation in the cockroach. II. Incorporation of D-glucose-^{14}C into bound carbohydrate. (Lipke, H. et al., 1965)
53 Sites of fibroin formation in the silk gland in *Bombyx mori*. (Akai, H., Kobayashi, M., 1965)
60 Formation of the specific structural and enzymic pattern of the insect flight muscle. (Bücher, Th. 1965)
64 The biosynthesis mechanism of silk fibroin. (Filippovich, Yu. B., 1964)
65 Brain glutamic acid decarboxylase and synthesis of γ-aminobutyric acid in vertebrate and invertebrate species. (Frontali, N., 1964)
66 Biosynthesis of drosopterin in the eye pigment of *Drosophila melanogaster*. (Goto, M. et al., 1964)
70 Incorporation of ^{14}C-glycine into the proteins of the fat body of the desert locust during ovarian development. (Hill, L., 1965)
80 The chemistry and physiology of the brain hormone. (Kobayashi, M., 1963)
86 Protein synthesis in silk glands. V. Relation of ribosomes to endoplasmic reticulum during fibroin synthesis. (Miura, Y. et al., 1964)
92 Revealing of intermediate stages of protein synthesis in the nuclei of *Drosophila melanogaster* salivary gland cells. (Platova, T.P., 1965)
96 On the contribution of the follicle epithelium to the deposition of yolk in the oocyte of *Panorpa communis* (Mecoptera). (Ramamurty, P.S., 1964)
97 Experimental activation of specific loci in polytene chromosomes of *Drosophila*. (Ritossa, F.M., 1964)
99 Yolk protein uptake in the oocyte of the mosquito *Aedes aegypti* L. (Roth, T.F., Porter, K.R., 1964)
100 Acetylcholinesterase in motor end-plates evaluated by electron microscope autoradiography. (Salpter, M.M., O'Connor, A., 1965)
102 Tyrosine metabolism of insects. XIII. Autoradiographic localization of tyrosine metabolites in the cuticle of *Schistocerca gregaria*. (Schlossberger-Raecke, I., Karlson, P., 1964)
107 Participation of ribosomes in the biosynthesis of silk fibroin. (Smirnov, V.N. et al., 1964)
111 Nucleotide composition of rapidly tagged ribonucleic acid in silk gland of *Bombyx mori*. (Antonov, A.S. et al., 1964)
112 An autoradiographic study of RNA synthesis in isolated salivary glands of *Drosophila hydei*. I. Autoradiographic studies. (Arnold, G., 1965)
113 RNA metabolism in pupae of the oak silkworm, *Antheraea pernyi*: The effects of diapause, development, and injury. (Barth, R.H., Jr. et al., 1964)
114 The labelling of individual chromatids of giant chromosomes with ^{3}H-thymidine. (Beermann, W., Pelling, C., 1965)
115 Correlation of genetic activity, heterochromatization, and RNA metabolism. (Berlowitz, L., 1965)
119 Nucleolus: A site of transfer ribonucleic acid synthesis. (Birnstiel, M.L. et al., 1965)
122 Puffing changes in incubated and in ecdysone treated *Chironomus tentans* (Clever, U., 1965)
123 Les "puffs" des chromosomes géants révèlent l'activité de gènes que déclenchent une hormone. (Dajoz, R., 1964)
124 Synthetic activities during spermatogenesis in the locust. (Das, N.K. et al., 1965)
125 (Gay, H., 1963)
126 New evidence on chromosome structure and function. (Gay, H., 1964)
129 RNA synthesis during male meiosis and spermiogenesis. (Henderson, S.A., 1964)
II 320 Ribonucleic acid metabolism in the posterior silkgland of silkworm, *Bombyx mori*, during the fifth instar. (Hosoda, J. et al., 1963)

130 Synthesis of RNA (ribonucleic acid) in vitro stimulated in dipteran salivary glands by 1,1,3-tricyano-2-amino-1-propene. (Jacob, J., Sirlin, J.L., 1964)
131 Content of nucleic acids in silk glands of silkworm varieties differing by their productivity. (Kulleyev, P., 1965)
132 RNA (ribonucleic acid) biosynthesis in the silk gland of the silkworm. (Kulleyev, P. et al., 1964)
133 Sedimentation characteristics of rapidly labelled RNA from the salivary gland cells of *Rhynchosciara angelae.* (Lara, F.J.S. et al., 1965)
134 Some factors influencing the utilization of tritiated thymidine in grasshopper embryos. (Leach, W.M., 1965)
135 Retention of tritiated thymidine in grasshopper neuroblasts. (Leach, W.M., 1964)
137 Metabolism of ribonucleic acid (RNA) in the silk gland of *Samia ricini.* (Lu, C.-H. et al., 1964)
138 Ribonucleic acid in the silk gland of silkworm (*Attacus ricini*) (Lu, C.-H. et al. 1964)
142 Protein synthesis in silk glands. VI. RNA metabolism in fifth instar larvae. (Miura, Y., 1965)
143 Autoradiographic study of nucleic acid synthesis during spermatogenesis in the grasshopper, *Melanoplus differentialis.* (Muckenthaler, F.A., 1964)
144 Autoradiographic study of nucleic acid synthesis during spermatogenesis in the grasshopper, *Melanoplus differentialis.* (Muckenthaler, F.A., 1964)
147 On the presence of DNA in larval salivary gland nucleoli in *Drosophila melanogaster.* (Nash, D., Plaut, W., 1965)
148 X chromosome DNA replication, developmental shift from synchrony to asynchrony. (Nicklas, R.B., Jaqua, R.A., 1965)
149 L'incorporation de la thymidine au cours de l'ovogenèse et du développement embryonnaire chez la drosophile. (Nigon, V., Gillot, S., 1964)
150 RNA and DNA synthesis during activation and secretion of the prothoracic glands of saturniid moths. (Oberlander, H. et al., 1965)
151 Fibroin synthesis in posterior silk glands. VI. Metabolic changes in RNA during the fifth instar. (Ogoshi, S., 1965)
152 Autoradiographic study of nucleic acid synthesis during spermatogenesis in *Drosophila melanogaster.* (Olivieri, G., Olivieri, A., 1965)
153 Presence of a different sequence in the terminal region of glycine-specific tRNA [transfer RNA]. (Onodera, K. et al., 1965)
154 Glycine-specific transfer ribonucleic acid (t-RNA) in the posterior silk gland of *Bombyx mori.* (Onodera, K., Komano, T., 1964)
158 RNA synthesis by the giant chromosomes of *Chironomus tentans.* (Pelling, C., 1964)
160 Localized DNA synthesis in polytene chromosomes and its implications. (Plaut, W., Nash, D., 1964)
161 An autoradiographic study of RNA systhesis in isolated salivary glands of *Drosophila hydei.* II. Interferometric studies. (Pollister, A.W., 1965)
162 On the origin of the RNA in the growing egg cells of *Panorpa communis* (Insecta, Mecoptera). (Ramamurty, P.S., 1963)
163 The incorporation of uridine-^{3}H into the cellular structures of the silk gland and the effect on this process of actinomycin D. (Ramenskaya, G.P., 1965)
164 Behaviour of RNA and DNA synthesis at the puff level in salivary gland chromosomes of *Drosophila.* (Ritossa, F.M., 1964)
165 The action of ribonuclease on salivary gland cells of *Drosophila.* (Ritossa, F.M. et al., 1964)
166 On the action of ribonuclease in salivary gland cells of *Drosophila.* (Ritossa, F.M. et al., 1965)
167 Localization of the additional RNA synthesis in trypsin-treated giant chromosomes of *Tendipes thummi.* (Robert, M., Kroeger, H., 1965)
168 Recent autoradiographic observations on the incorporation of labelled precursors of nucleic acids and proteins in the fatty bodies of *Musca domestica.* (Russo-Caia, S., 1964)
169 Ribonucleic acid synthesis in neuroblast of the grasshopper *Chortophaga viridifasciata.* (Schiff, S.O., 1965)
170 Ribonucleic acid synthesis in neuroblasts of *Chortophaga viridifasciata* (de Geer), as determined by observations of individual cells in the mitotic cycle. (Schiff, S.O., 1965)
174 The mechanism of action of hormones. V. The effect of ecdysone on RNA metabolism in the epidermis of the blowfly, *Calliphora erythrocephala.* (Sekeris, C.E. et al., 1965)

175 Ribonucleic acid synthesis of silk-secreting gland of *Bombyx mori.* (Smirnov, V.N. et al., 1964)
176 The ribonucleic acid from the silk gland of the silkworm and the amino acid code. (Szafrański, P. et al., 1964)
177 Distribution of tritium-labelled DNA among chromosomes during meiosis. I. Spermatogenesis in the grasshopper. (Taylor, J.H., 1965)
178 Cytochemical and autoradiographic observation of nucleic acid metabolism in the oogenesis of *Dytiscus marginalis.* (Urbani, E., Russo-Caia, S., 1964)
179 Synthesis and transfer of DNA, RNA, and protein during vitellogenesis in *Rhodnius prolixus* (Hemiptera). (Vanderberg, J.P., 1964)
181 Evidence for a lampbrush type structure in grasshopper spermatocyte chromosomes. (Watkins, M.J., 1964)
182 The metabolism of ribonucleic acid in cecropia silkmoth pupae in diapause, during development and after injury. (Wyatt, G.R., Linzen, B., 1965)
197 Phospholipid composition of flight muscle sarcosomes from the housefly, *Musca domestica.* (Crone, H.D., 1964)
198 Some aspects of lipid catabolism in saturniid moths. (Domroese, K.A., 1964)
199 The role of lipid in adult development and flight muscle metabolism in *Hyalophora cecropia.* (Domroese, K.A., Gilbert, L.I., 1964)
224 Regulation of cockroach fat-body metabolism by the corpus cardiacum in vitro. (Wiens, A.W., Gilbert, L.I., 1965)
226 Studies in D-serine and D-2,3-diaminipropionic acid in *Bombyx mori.* (Corrigan, J.J., 1965)
258 Blood volume and water content of the male American cockroach, *Periplaneta americana* L. – Methods and the influence of age and starvation. (Wharton, D.R.A. et al., (1965)
264 Some physiological aspects of adult reproductive diapause in the chrysomelid beetle, *Galeruca tanaceti* (Linn.). (Siew, Y.C., 1963)
265 The endocrine control of adult reproductive diapause in the chrysomelid beetle, *Galeruca tanaceti* (L.)III. (Siew, Y.C., 1965)
266 Biochemical changes associated with growth and development of the larval blowfly *Phormia regina* (Meigen). (Wimer, L.T., 1963/64)
268 The action of serum albumin on oxidative phosphorylation in insect mitochondria. (Wojtczak, L., Wojtczak, A.B., 1959)
299 Study of the flight range and gonotrophic cycles in *Anopheles stephensi* using ^{32}P. (Quraishi, M.S., 1964)

10. Miscellaneous (including Nutrition, Metabolism and Growth Phenomena, Respiration)

255 Devine, T., Wharton, G.W. TRANSPIRATION AND SORPTION OF WATER BY ACARINES AT EQULIBRIUM. *Bull. ent. Soc. Am.* *11*, 3 (1965) 173. Abstr.382. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

Tritiated water was found to move in or out of female *Echinolaelaps echidninus* and larval *Dermacentor andersoni* when exposed to atm whose relative humudity was at 93%. The tritiated water moved along an activity gradient from high to low. At 93% relative humidity both acarines can maintain an equilibrium weight. (Abstr.)

256(1) Marcuzzi, G., Santoro, V. STUDIES ON THE WATER EXCHANGE OF *Tenebrio molitor* BY TRITIATED WATER. *Ricerca scient.* *12* (1959) 2576-81. (In Italian)

The exchange of water in larvae of *T. molitor* was studied by utilizing tritiated water as the radioactive tracer. The results show that the rate of water exchange between the larva and its surrounding surrounding environment was identical (half-time of 198 ± 21 h) either when the ambient amount was saturated with water vapour or when the relative humidity was 85%. This is especially interesting in view of the fact that at a humidity of 100% the insects are hygroscopic, while in a relative humidity of 85% the insects neither absorb nor lose water. (CA 54: 1960, 16677a)

257 Treherne, J.E. ACTIVE TRANSPORT IN INSECTS. p. 1-13 of "Aspects of Insect Biochemistry. Biochemical Society Symposium No. 25, London, 1. Apr. 1965". Goodwin, T.W., Ed. London, Academic Press. 1965, 107p.

The author reviews data for various insects on the active transfer of water and of inorganic ions. Their transfer across the cell membrane is examined, particular attention being paid to sodium, potassium, and chloride ions. (In a number of the studies cited radioisotopes had been used although this fact is not stressed in the text.) Several unusual features can be seen to be involved in these processes, and there is likely to be diversity of transport mechanisms in insect cells and tissues; even sodium and potassium transport can probably not be accounted for by a single mechanism.

258 Wharton, D.R.A., Wharton, M.L., Lola, J.E. BLOOD VOLUME AND WATER CONTENT OF THE MALE AMERICAN COCKROACH, Periplaneta americana L. - METHODS AND THE INFLUENCE OF AGE AND STARVATION. J. Insect Physiol. 11, 4 (1965) 391-404.

The water per cent changes little, if at all, with the age of the adult insect. The blood volume per cent decreases markedly during the first 4 d and only slightly thereafter. There was no correlation between the daily fluctuations of blood volume per cent and those of total water per cent. Whereas the total water per cent remained relatively stable in the fed insect after the first week, it increased to a significant degree in the starved insect, especially after the 6th d of starvation in both the insects examined whole and eviscerated. The blood volume per cent decreased as a result of starvation. The blood volume per cent of 36·3 ± 0·68 (for 2- to 3-week-old males) is much higher than previously reported. Within 4-fold limits (15 000-62 000 cpm) the dose of ^{14}C inulin injected had no significant effect on the blood volume. Heating the insect at 50 or 55°C did not alter the blood volume, but heating at 60°C for 15 s caused an increase. Heating at 60°C for 1 min coagulated the outer tissues of the insect and made bleeding difficult. Chilling, which retarded coagulation, failed to change the blood volume. Starvation reduced coagulation. It also reduced the blood volume which nevertheless stayed at a high level. Age and starvation are discussed with respect to their influence on water balance. The findings are also discussed with respect to the techniques employed by ourselves and other investigators. (Auth.)

259 Cohen, A.J., Smith, J.N. COMPARATIVE DETOXICATION. 9. THE METABOLISM OF SOME HALOGENATED COMPOUNDS BY CONJUGATION WITH GLUTATHIONE IN THE LOCUST. Biochem. J. 90, 3 (1964) 449-56.

The study was carried out in order to determine whether cysteine or glutathione conjugates were formed in locusts from compounds like benzyl chloride that contain labile or reactive halogen. Such simple compounds might serve as models for the more complex chlorinated insecticides. Fifth-instar hoppers or adults of Schistocerca gregaria were used. They were dosed with Dl-[^{35}S]cysteine or labelled sodium cystinate, benzyl chloride being injected subsequently. The various experimental procedures are given. S-(p-Nitrobenzyl)glutathione, S-(naphth-1-yl-methyl)glutathione, S-(2-phenylethyl)glutathione and a glutathione conjugate of phenoltetrabromophthaleindisulphonate were synthesized. Locusts rapidly metabolized p-nitrobenzyl chloride to S-(p-nitrobenzyl)glutathione. This glutathione conjugate was subsequently hydrolysed in locust gut, Malpighian tubes and excreta to S-(p-nitrobenzyl)cysteine, which was in turn converted into unidentified products. Glutathione conjugates and cysteine conjugates of phenoltetrabromophtaleindisulphonate, benzyl chloride, p-chlorobenzylchloride, p-nitrobenzyl bromide, 1-chloro-2,4-dinitrobenzene, 1-fluoro-2,4-dinitrobenzene and 3,4-dichloro-1-nitrobenzene have been identified chromatographically in locusts dosed with these compounds.

260 Kumar, S.S., Hodgson, E. METABOLISM OF CHOLINE IN Periplaneta americana. Bull. ent. Soc. Am. 10, 3 (1964) 164. Abstr.

Choline metabolism has been investigated in 5th-instar roaches by injection of either methyl-^{14}C-choline or 1,2-^{14}C-choline followed by purification and identification of metabolites. Phosphoryl choline appears to be the principal water soluble metabolite and investigations are proceeding on its biosynthesis. ^{14}C-choline is incorporated into phosphatidyl choline. (Abstr.)

261 Lambremont, E.N., Stein, C.I. $C^{14}O_2$ PRODUCTION IN THE BOLL WEEVIL, Anthonomus grandis, AFTER INJECTION OF C^{14}-1-ACETATE. Ann. ent. Soc. Am. 58, 5 (1965) 765-6.

Newly emerged, unfed, adult weevils, reared aseptically were weighed and then anaesthetized with CO_2 in a sterile container for 30 min. Each was then injected in the abdomen with 1 µl of ^{14}C-1-acetate solution delivering 0.2 µCi of ^{14}C and 14.8 µg of sodium acetate. In the initial series of tests, 22 injected adults were placed in the metabolism cage and $^{14}CO_2$ was collected at 10 min intervals for 1½ h. Results indicate that acetate injected into the boll weevil undergoes almost immediate oxidative metabolism, with significant ^{14}C appearing in the CO_2 within 10 min. The decline in $^{14}CO_2$ release after about 1 h suggested that from that point onward progressively less acetate was available for various biosynthetic processes. Since the release rate at 2 h was about half that at the 1 h maximum, a 2 h incubation period would probably include the most productive time for synthesis of fatty acids.

262 Luedicke, M., Peterhänsel, H. DIE MARKIERUNG BESTIMMTER PIGMENTFELDER AUF DEN FLÜGELN VON SCHMETTERLINGEN MIT ^{35}S-NATRIUMSULFAT- UND ^{35}S-DL-CYSTINLÖSUNGEN. (Labelling of certain areas of pigmentation on butterfly wings with ^{35}S-sodium sulphate and ^{35}S-DL-cystine solutions). Naturwissenschaften 52, 5 (1965) 113-4. (In German)

The larva of Araschnia levana, Inachis io, Aglais urticae, Papilio demodocus, Rhyparia purpurata, and Arctia caja were grown on the feed plants treated with labelled compounds, or the labelled compounds were injected between the abdominal segments of the larvae. The localization of isotopes was detected in the pigments of wings of young butterflies. The isotopes were found in the red, red-brown, red-yellow, and dark-yellow spots containing different degree of oxidation of ommochrome, and none or very little with brown, light-yellow, and black spots. (CA 62; 1965, 13560e)

263 Self, L.S. ADAPTION OF INSECTS TO TOBACCO. Diss. Abstr. 26 (1965) 1232.

The mechanisms enabling certain insects to adapt to tobacco as a primary food source were studied utilizing radiometric, chromatographic, and spectrophotometric techniques. Nicotine was metabolized to other alkaloids in all insects studied with the exception of lepidopterous larvae, in which case nicotine was excreted intact. There was no evidence for the metabolism of nicotine after the administration of topical, injected, and ingested doses to the tobacco hornworm, Protoparce sexta (Johannson). Dissections of the larval tissues after ingestion of tomato foliage pre-treated with ^{14}C-nicotine showed that the non-eliminated radioactive nicotine was localized in the digestive tract. Topical and injected doses of nicotine also were excreted unchanged in the larval faeces. Following ingestion of tobacco foliage, the alkaloids in the tobacco plant were eliminated unchanged in the hornworm faeces within 30 min. At least 4 µg of nicotine were detected in the blood of larvae feeding on tobacco. Two other lepidopterous pests of tobacco, the tobacco budworm, Heliothis virescens (Fabricius), and the cabbage looper, Trichoplusia ni (Hübner), also appeared to tolerate the alkaloids in the tobacco plant because of an efficient excretory mechanism. The differential grasshopper, Melanoplus differentialis (Thomas), metabolized a topical dose of nicotine to four metabolites that were recovered in the faeces. Three alkaloids were recovered in the faeces of tobacco-fed grasshoppers which were not present in the tobacco plant. One of the metabolites was identified as cotinine, and a second metabolite was tentatively identified as a quaternary ammonium compound. In the tobacco wireworm, Conoderus vespertinus (Fabricius), a similar pattern of metabolism appeared and the primary metabolic product had paper chromatographic properties consistent with cotinine. The cigarette beetle, Lasioderma serricorne (Fabricius), apparently metabolized nicotine to other alkaloids. Musca domestica Linnaeus metabolized approximately 80% of a topical dose of nicotine to cotinine and two other metabolites. The enzymatic degradation of nicotine by house fly microsomes was activated by DPNH and TPNH, and influenced by nicotinamide and the pH of the incubation mixture. (From DA).

264(2) Siew, Y.C. SOME PHYSIOLOGICAL ASPECTS OF ADULT REPRODUCTIVE DIAPAUSE IN THE CHRYSOMELID BEETLE, Galeruca tanaceti (Linn.). Thesis. London Univ. (England). May 1963, 190p.

Five types of neurosecretory cells (A, A_1, B, C and D) occur in the brain and the subesophageal ganglion. These cells undergo short cycles of secretory activity throughout adult life, which become shorter but more intense towards and at the phase of oviposition. The results stem from two experimental sources: (1) measurements of nuclear volumes of these cells, and (2) autoradiographic investigations using ^{35}S-DL-cystine. The corpus cardiacum/allatum complex functions in relation to the level of activity in the neurosecretory cells. Three criteria were used to determine the corpus cardiacum/allatum activity: (1) increase in volume of the glands, (2) decrease in nuclear-cytoplasmic ratios, and (3) increase in nuclear volumes. Cauterization and implantation experiments indicated a close inter-relationship between the neuro-endocrine centres, and the possibility of complex feed-back mechanisms. Respiratory rates, fat and water contents in the pre-diapause, diapause, and ovarial maturation phases were compared.

265 Siew, Y.C. THE ENDOCRINE CONTROL OF ADULT REPRODUCTIVE DIAPAUSE IN THE CHRYSOMELID BEETLE, Galeruca tanaceti (L.) III. J. Insect Physiol. 11, 7 (1965) 973-81.

The use of radioactively labelled amino acid ^{35}S-DL-cystine in autoradiographic studies substantiated previous findings that the phases of diapause, ovarian maturation, and oviposition in G. tanaceti are controlled by different levels of neuro-endocrine activity. The rate of turnover of radioactive cystine increases about 2-fold when a mature female begins to oviposit and about 10-fold when a female goes from diapause to oviposition. Results from this study also substantiate histological evidence that there is a differential rate of storage and of discharge of neurosecretory material from the corpus cardiacum. In diapausing females there is a build up of ^{35}S in the corpus cardiacum up to 120 h after injection with ^{35}S-DL-cystine, whereas in ovipositing females most of the radioactive substances accumulated in the corpus cardiacum is discharged within 24 h. The dynamics of neurosecretion are discussed. (Auth.)

266 Wimer, L.T. BIOCHEMICAL CHANGES ASSOCIATED WITH GROWTH AND DEVELOPMENT OF THE LARVAL BLOWFLY, Phormia regina (Meigen). Diss. Abstr. 24 (1963/4) 2631-2.

Radioactive glucose has been used as a substrate for the investigation of certain biochemical changes associated with growth and development of the insect larva. The larvae of P. regina (Meigen) were reared under rigidly controlled conditions in order to eliminate variations of environmental and nutritional origin. It was found that larval weight could be used as a basis for the determination of physiological age with a minimum of variation in stage of development. Larvae of similar physiological age were then selected for experimentation on each day of 3d instar development. The wet weight and dry weight of the whole larva and of the fat body were determined, and the per cent of larval dry weight represented by the fat body was calculated. The growth of the fat body was then compared with that of other selected larval tissues on the basis of dry weight determinations. The per cent radioactivity incorporated into the various body tissues and evolved as CO_2 was measured following the dissection of larvae previously injected with glucose uniformly labelled with ^{14}C. An evaluation of the data has indicated that the fat body is important in the synthesis and storage of glucose metabolites. The fat body was fractionated and analysed for its major organic components. The total amounts of fat, carbohydrate (glycogen and other anthrone positive material), and protein were determined. An analysis of the per cent radioactivity incorporated into these fractions was then made, and the data discussed with reference to larval growth and development. The importance of biochemical investigations of this type in the study of hormonal control mechanisms has also been mentioned. (DA)

267 Gregg, C.T., Johnson, J.R., Heisler, C.R., Remmert, L.F. INHIBITION OF OXIDATIVE PHOSPHORYLATION AND RELATED REACTIONS IN INSECT MITOCHONDRIA. Biochim. biophys. Acta 82 (1964) 343-49.

The effects of the uncoupling agent 2,4-dinitrophenol (DNP) and the insecticide DDT on respiration, phosphorylation, and the ATPase and ATP-P_i exchange activities of house fly mitochondria were investigated. For assay of the ATP-P_i exchange reaction, incorporation of ^{32}P was determined. DDT at 0.1 mM abolishes phosphorylation, the ATP-P_i exchange, and the DNP-stimulated ATPase activity in these mitochondria. DDT does not, however, affect the Mg^{2+}-stimulated ATPase activity; in this respect it appears to be unique among known uncouplers or inhibitors of mitochondrial ATPase. DDT also inhibits that portion of the total respiration which is "tightly-coupled" to oxidative phosphorylation: "uncoupled" respiration is not depressed by DDT. Anomalously, DNP frequently strongly inhibits respiration in the presence of ADP and P_i and fails to stimulate pyruvate oxidation in the absence of ADP and P_i.

268(1) Wojtczak, L., Wojtczak, A.B. THE ACTION OF SERUM ALBUMIN ON OXIDATIVE PHOSPHORYLATION IN INSECT MITOCHONDRIA. Biochim. biophys. Acta 31 (1959) 297-9.

Using mitochondria from larvae of the wax moth, Galleria mellonella L., a pronounced stimulatory effect on the oxidative phosphorylation was observed with both human and bovine serum but with neither egg albumin nor an albumin fraction from an acetone powder of frog muscle. To explain the nature of this effect the adenosine triphosphate (ATP)-orthophosphate exchange reaction was investigated. The incubation medium also contained a phosphate buffer (pH 7.5) to which 5 µCi ^{32}P (3 µM) had been added. Results indicate that an inhibitor of the exchange reaction (and perhaps of oxidative phosphorylation) is present in insect mitochondria and can be removed by washing with serum albumin solution. It is possible to extract this inhibitor by organic solvents after thermal coagulation of albumin from the washing fluid.

269(1) Wojtczak, L., Wojtczak, A.B. UNCOUPLING OF OXIDATIVE PHOSPHORYLATION AND INHIBITION OF ADENOSINE TRIPHOSPHATE-ORTHOPHOSPHATE EXCHANGE BY A SUBSTANCE FROM INSECT MITOCHONDRIA. Biochim. biophys. Acta 39 (1960) 277-86. (In English)

Human and bovine serum and plasma albumins, and to a lesser extent β-lactoglobulin, stimulated oxidative phosphorylation and adenosine triphosphate-ortophosphate exchange in mitochondria from whole larvae of the greater wax moth, Galleria mellonella. This effect was the result of the removal by the proteins of an uncoupling agent present in isolated mitochondria. The uncoupling agent was found to contain fatty acids, of which palmitic, stearic, oleic, linoleic, and linolenic acids were identified by paper chromatography. It could be isolated by washing the mitochondria with a sucrose-albumin solution and subsequent extraction of the washing fluid with organic solvents. Besides the five fatty acids, other active components were also present; eluates from paper chromatograms of the inhibitor inhibited adenosine triphosphate-orthophosphate exchange. ATP-P_i exchange was investigated using a medium slightly modified from that described by Hülsmann et al. (ibid. 267), which contained ^{32}P (3 µM, ~10^6 cpm) in a phosphate buffer pH 7.5. ^{32}P-ATP was formed. Preliminary experiments on ATP-ADP exchange were carried out in the same medium except that ^{32}P was omitted and 3 µM ADP containing about 150 000 cpm [^{32}P]ADP were added. For the preparation of [^{32}P]ADP, see p. 853 in "Methods in Enzymology". Vol. 4. New York, Academic Press. 1957.

270 Yurkiewicz, W.J. FLIGHT EXHAUSTION STUDIES ON THE BLOW FLY Phaenicia sericata USING C^{14}-LABELED SUCROSE. Ann. ent. Soc. Am. 58, 5 (1965) 766.

Experiments were devised to determine the extent of carbohydrate depletion during flight to exhaustion at several temperatures (15°, 20°, 25°, and 30°C). The disappearance of ^{14}C-labelled sucrose was measured by feeding the exhausted fly a measured amount of fuel, and then recording the time taken to reach exhaustion again. Male flies (7 to 10 d old) were initially exhausted by attaching them to wire supports by a wax connection to the thorax and placing them before a fan. The loss of tarsal contact as the fly was picked up initiated flight while the moving air maintained continuous flight. The fly was considered exhausted if, on stopping, tarsal stimulation produced flights of <10 s on five successive trials. Flight time and wing beat frequency were recorded with stop watch and strobe light. Through the temperature range of 15-20°C wingbeat frequency increased from 128 to 177 cps. The metabolic rate as expressed by carbohydrate utilization increased from 18.2 to 37.5 mg sucrose-^{14}C/g live wt/h. At least between 15 and 30°C exhausted flies metabolize essentially all the carbohydrate fed to them.

271 Lloyd, D., Callely, A.G. THE ASSIMILATION OF ACETATE AND PROPIONATE BY Prototheca zopfii. Biochem. J. 97 (1965) 176-79.

The tricarboxylic acid and glyoxylate cycles are of major importance in the assimilation of acetate and propionate by P. zopfii. The pattern of assimilation of acetate-2-^{14}C and propionate-2-^{14}C by whole cells growing with their respective substrates is similar except that with propionate, β-hydroxypropionate is the first labelled intermediate detected. CO_2 fixation is of little quantitative importance for the growth of this organism with propionate. The yield of cells obtained/mole of acetate is similar to that obtained/mole of propionate and about half that obtained/mole of butyrate, these substrates acting as sole sources of C and energy. (CA 63: 1965, 10364b)

See also:

118 The nucleus-plasma relationship and its bearings on the giant growth of the egg cell. (Bier, K., 1964)

290 Comment caractériser le transit intestinal chez les guêpes sociales. Les conséquences biologiques. (Montagner, H., 1964)

570 *Drosophila* cytology and genetics. (Oak Ridge National Laboratory, 1965)
777 Metabolism of crickets. (Menhinick, E.F., 1964)
1047 A simplified ionization chamber procedure for the continuous measurement of respiratory $C^{14}O_2$ of insects. (Levenbook, L., Dinamarca, M.L., 1965)
1048 Continuous measurement of $C^{14}O_2$ respired by insects. An ionization chamber method. (Robinson, J.R., Chefurka, W., 1964)

C. ECOLOGY

1. General Articles. Surveys

272 Norris, K.R. THE BIONOMICS OF BLOW FLIES. *A. Rev. Ent.* *10* (1965) 47-68.

Review article. Radioisotopes were used for labelling larvae and for studying insect ecology (dispersion and population density). (The use of radioisotopes in studies covered elsewhere in this bibliography is not always mentioned specifically).

2. Behaviour

(a) Feeding*
(including Mechanisms of Feeding and Transmission of Food)

273 Abdel-Malek, A.A. STUDY OF THE FEEDING HABITS OF MALE *Anopheles sergenti* Theo. AT SIWA OASIS USING RADIOPHOSPHORUS. *Bull. Wld Hlth Org.* *30* (1964) 137-9.

The feeding habits of male *A. sergenti* were studied in Siwa, an oasis covering 200 km, at 22 m below sea level, approximately 600 km northwest of Cairo. The males were reared in the laboratory from larvae collected in the field. Samples of the various plants in and around the larval habitats were cut in the field under water, and subsequently labelled by keeping the cut stems dipped in 30 ml of $NaH_2{}^{32}PO_4$ (at 20 μCi/ml). Adult mosquitoes were then given the opportunity to feed on them. Out of the 40 species of plants investigated, only three proved suitable for food. In descending order of suitability these plants are *Salicornia fruticosa* (L.) L. (average: 324 cpm), *Alhagi maurorum* Medic. (145 cpm), and *Juncus arabicus* (Asch. et Buch.) Adams (47 cpm). Feeding took place on both flowers and leaves, and lasted 10 min on the average. A paper of the same title was presented at the "12th International Congress of Entomology, London, 8-16 July 1964", see ref. 274.

274 Abdel-Malek, A.A. STUDY OF THE FEEDING HABITS OF MALE *Anopheles sergenti* Theo. AT SIWA OASIS USING RADIOPHOSPHORUS. p. 758 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul. 1964". Freeman, P., Ed. London, Royal Entomological Society of London, 1965.

For abstract, see 273.

275 Auclair, J.L. RECENT ADVANCES IN THE FEEDING AND NUTRITION OF APHIDS. *Can. Ent.* *96*, 1-2 (1964) 241-9.

Recent developments on aphid digestive enzymes, aphid feeding, and nutrition on host plants and on artificial media are reviewed, with 39 references. Radioisotopes were utilized in a number of studies cited although this fact is not specifically mentioned in the text.

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* See also Food Chains (3-a).

276(1) Boormal, J.P.T. OBSERVATIONS ON THE FEEDING HABITS OF THE MOSQUITO *Aëdes* (*Stegomyia*) *aegypti* (Linnaeus): THE LOSS OF FLUID AFTER A BLOOD-MEAL AND THE AMOUNT OF BLOOD TAKEN DURING FEEDING. *Ann. trop. Med. Parasit.* *54* (1960) 8-14.

A batch of mosquitoes, used the 4th day after emergence, were allowed to feed on heparin-treated mouse blood (50 units/ml) confined over a mouse-skin membrane and made active by adding 0.1 ml of a solution containing ^{144}Ce or ^{35}S. The fluid passed from the gut of the mosquito immediately after a blood meal was studied, the volume of fluid being estimated at ~1.5 mm^3. It is suggested that this fluid is derived mainly from the blood meal, by absorption through the midgut wall and by excretion via the Malpighian tubes and hind gut. In a small number of cases whole blood was passed out. In these cases, when the blood meal contained living virus, virus was present in the faeces; when the blood was not passed, virus was absent from the faeces. It is concluded that defaecation after feeding is unlikely to be of importance as a means of mechanical transmission of virus (Semliki Forest virus, KMV strain). The use of radioisotopes for the estimation of blood meals size provides a method independent of faecal loss of fluid. These estimates were 68% higher than the commonly accepted estimates obtained by weighing insects before and after feeding. It is suggested that the normal size of a blood meal for *A. aegypti* is of the order of 4.0-4.5 mm^3.

277 Chauvin, R., Lecomte, J. SUR LES ECHANGES DU "DEUXIEME DEGRE" ENTRE COLONIES FILLES DE *Formica polyctena* ETUDIES AU MOYEN DES RADIO-ISOTOPES. *Insectes soc.* *11*, 2 (1964) 97-104. (With English summary)

Le transfert d'isotopes (^{198}Au) entre les colonies filles de *Formica polyctena*, à partir d'une des colonies marquées, suit des voies préférentielles, malgré l'activité des butineuses plus ou moins également réparties entre les fourmilières. Certaines colonies procèdent à des échanges actifs de glucides et d'isotopes, d'autres ne reçoivent rien ou presque rien. Le transfert est limité d'ailleurs à une petite fraction de la quantité totale qui a été distribuée. Le marquage a été effectué à l'aide de 30 mCi de ^{198}Au. L'or était mélangé à 3/4 de litre ou 1/2 litre de sirop sucre à 50% au moment de l'emploi et l'ensemble était versé sur le sommet du dôme d'une des fourmilières.

278 Dame, D.A., Fye, R.L. STUDIES ON FEEDING BEHAVIOR OF HOUSE FLIES. *J. econ. Ent.* *57*, 5 (1964) 776-7.

The study was undertaken in order to determine the age at which *Musca domestica* L. begins feeding and the relative acceptability of liquid versus dry bait formulations. Young flies were allowed to begin ad libitum feeding on radioactive (^{32}P) or poisoned baits at the time of emergence and determining the resulting radioactivity or mortality at various intervals. (120 μCi of ^{32}P-phosphoric acid was mixed with 15 g sugar and about 0.5 g placed in each cage; 990 flies were used in the ^{32}P-tests). Results are shown graphically. No difference in feeding behaviour was found between the sexes. On the liquid bait 50% of the flies had fed by the 5th and more than 90% by the 12th hour when only 50% had fed on the dry baits. Since fly mating does not occur before the 16th hour, a liquid bait-chemosterilant placed in a breeding site may be expected to be more effective than a dry bait.

279 Devine, T.L., Venard, C.E., Myser, W.C. MEASUREMENT OF SALIVATION BY *Aedes aegypti* (L.) FEEDING ON A LIVING HOST. *J. Insect Physiol.* *11* (1965) 347-53.

A. aegypti mosquitoes having tritiated water in their body fluids were permitted to feed on living suckling mice. The quantity of saliva a mosquito left in a mouse was computed as the ratio of the radioactivity of the ^3H found in the mouse and of the specific activity in the mosquito fluids. The fluids were extracted from individual mice and individual mosquitoes by lyophilization, and they were assayed for ^3H in a liquid scintillation spectrometer. The quantity of saliva left in a mouse when a mosquito took a blood meal had a range of 1-13 μg, with a mean of 4.7 μg. (Auth.)

280 Entwistle, P.F., Longworth, J.F. *Rep. W. Afr. Cocoa Res. Inst.* 1962/63 (1964) 87p.

During investigations on the feeding behaviour of the mealybugs, radioactivity counts were made on adults and nymphs of *Planococcoides njalensis* (Laing) that had fed for 24 h on young wood and on old secondarily thickened stems of cacao seedlings of which the second leaf from the apex had previously been exposed for 3 h to carbon dioxide [$^{14}CO_2$]. Counts per minute for mealybugs on the young stems were 218 for adults directly in line below the treated leaf, 15 for adults below but not in line with it and 108 for nymphs from all round the stem; for adults and nymphs on the old stems, they were 1105 and 501, respectively, and the background count was about 16. In sections of the old stems that were mounted, covered with photographic emulsion and developed after storage in a deep-freeze for 16 d, the silver grains of the emulsion were located over the youngest phloem near the cambium, indicating that *P. njalensis* can feed in the phloem; whether it does so exclusively is not known. (From RAE-A 52: 1964, 568)

281 Kasting, R., McGinnis, A. J. MEASURING CONSUMPTION OF FOOD BY AN INSECT WITH CARBON-14 LABELED COMPOUNDS. *J. Insect Physiol.* *11*, 9 (1965) 1253-60.

A radioisotopic procedure was investigated in which sucrose-U-^{14}C or cellulose-U-^{14}C was incorporated into artificial diets. Measurements of food consumption by 5th-instar larvae of the pale western cutworm, *Agrotis orthogonia*, by the radioisotopic method and either the gravimetric or chromic oxide methods agreed well. Results from applying the radioisotopic method to individual 1st-instar larvae of the cutworm fed a sprout and cellulose (1 : 1) diet varied with the individual; the quantities consumed ranged between 1.4 and 24 γ for a 6 h feeding period. However, significant differences in the quantities of some diets consumed by 1st-instar larvae could be detected by the radioisotopic method. It was concluded that the radioisotopic procedure offers a means of measuring and comparing the quantities of food consumed by very small insects. (CA 63: 1965, 15261g)

282 Lee, W.R. RELATION OF DISTANCE TO FORAGING INTENSITY OF HONEY BEES (*Apis mellifera*) ON NATURAL FOOD SOURCES. *Ann. ent. Soc. Am.* *58*, 1 (1965) 94-100.

In experiments conducted during two seasons, several variables affecting the relation of distance to foraging intensity were tested simultaneously by labelling bees with genetic markers and either ^{32}P or ^{131}I. During one season the weather, though variable, permitted normal flight and there was no significant variation among the days sampled; during the other season cold weather and frequent rains limited flights to short, intermittent periods and there was large variation among samples taken on different days at the same location. Weather, having a major effect only under marginal flight conditions, is therefore a "threshold" factor. During the season when weather permitted normal flight, the bees were so distributed that a linear relation to distance was found in the proportion of bees between any two of the three apiaries. When the proportion of distance that bees from each apiary had to fly to the sampled location was plotted against the proportion of bees for each location, the steep slope of each line obtained indicated a rapid decrease in relative attractiveness of a food source with increased distance from the apiary. The body-colour mutation "cordovan" did not affect the distribution of foragers or their pollen-gathering activity. During the season when weather conditions permitted normal flight, ^{131}I showed no effect on the distribution of foragers, but ^{32}P had a slight effect. Even if the data from the apiary that was fed ^{32}P are omitted, it is concluded that there is a rapid decrease in relative attractiveness of a food source with increased distance from the apiary. (Auth.)

283 Orenski, S.W., Murray, J.R., Maramorosch, K. FURTHER STUDIES ON THE FEEDING HABITS OF ASTER YELLOWS VIRUS-CARRYING CORN LEAFHOPPERS. *Contr. Boyce Thomson Inst. Pl. Res.* *23*, 3 (1965) 47-50.

No significant differences were found in the isotope uptake from ^{32}P-labelled China aster (*Callistephus chinensis*) leaves by virus-free or viruliferous insects (*Dalbulus maidis*). The more prolonged survival on healthy asters of viruliferous insects is apparently the result of greater digestibility of the sap. The isotope uptake by both virus-free and viruliferous insects was several-fold greater on diseased asters than on healthy plants. (CA 63: 1965, 13705h)

284 Seay, T.N., Rodriguez, J.G. THE EFFECT OF COLORED LIGHTS ON INGESTION BY IMMATURE TWO-SPOTTED SPIDER MITES. *Bull.ent. Soc. Am.* *11*, 3 (1965) 160. Abstr. 112. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

A technique has been developed whereby immature two-spotted spider mites, *Tetranychus urticae* (Koch), may be fed sucrose solutions or chemically defined diets through a collodion membrane. The effect of coloured lights on ingestion may be determined by incorporating the radioisotope ^{32}P into the solutions or diets. (Abstr.)

285 Strong, F.E., Landes, D.A. FEEDING AND NUTRITION OF *Lygus hesperus* (HEMIPTERA: MIRIDAE). II. AN ESTIMATION OF NORMAL FEEDING RATES. *Ann. ent. Soc. Am.* *58*, 3 (1965) 309-14.

Four methods were employed to determine the amounts of food ingested by *L. hesperus* Knight. Three of them were satisfactory. (1) By weighing the food source before and after being fed upon, adult males were found to consume an amount equal to 112% of their body weight per 24 h. (2) When ^{32}P was utilized as a tracer, 3rd-instar nymphs were found to ingest an amount equal to 283% of their initial weight in 24 h. Expressed as a percentage of body weight, the amounts ingested per unit time decreased as the nymphs matured. (^{32}P was added to fresh bean juice in the form of $H_3{}^{32}PO_4$, to yield 195 cpm/µl of juice. Preliminary experiments on oral secretions with ^{86}Rb, which is not metabolized, indicated that during their feeding activities *L. hesperus* apparently recycles appreciable amounts of fluid; this suggests that values obtained with ^{32}P measured gross rather than net food consumption, for ^{32}P is not recycled back into the host. (3) A direct estimate of food consumption was obtained when bugs were fed through a Parafilm membrane sealing the end of a food tube connected to a capillary. Females were thus found to ingest an amount equal to 169% of their body weight in 24 h, while males ingested only 98% of theirs.

See also:

20 A change in the activity of feeding and mobility of the fleas *Xenopsylla cheopis* marked with radioactive phosphorus ^{32}P. (Kharlamov, V.P., 1965)
32 Radiocesium accumulation and feeding by willow leaf beetles (*Chrysomela knabi* Brown). (Crossley, D.A., Jr., 1964)
33 Biological half-life for radiocesium in aphids. (Crossley, D.A., Jr., 1964)
242 Analytical and histological study of the head and thorax glands in the honeybee *Apis mellifica*. (Hanser, G., Rembold, H., 1965)
288 The wood-destroying carpenter ant and its importance in forestry studied by tracer technique. (Kloft, W., Hölldobler, B., 1964)
289 Radiotracer investigations to determine the nest area of wood-destroying ants *Camponotus herculeanus* AND *C. ligniperda* Latr. (Kloft, W. et al., 1965)
290 Comment caractériser le transit intestinal chez les guêpes sociales. Les conséquences biologiques. (Montagner, H., 1964)
291 Etude du comportement alimentaire et des relations trophallactiques des mâles au sein de la société de guepes au moyen d'un radio-isotope. (Montagner, H., 1964)
305 Landscape studies using radioactive tracers: III. Interdependence between arthropod food chains in a tulip poplar forest. (Crossley, D.A., Jr., 1963)
318 Swarming, mating, and density in nature of *Anopheles stephensi mysorensis*. (Quraishi, M., 1965)

(b) General Behaviour

286 Dame, D.A., Schmidt, C.H. P^{32}-LABELED SEMEN FOR MOSQUITO MATING STUDIES. Radioactive semen of male *Anopheles quadrimaculatus* Say and *Aedes aegypti* (L.), reared in media containing 0.1, 0.25, and 0.5 µCi/ml of ^{32}P per larva, was detected in the spermathecae of their mates after copulation. The radioautographic techniques employed for detection of semen from treated males can be utilized in field investigations of mosquito-mating behaviour. Furthermore, male *A. quadrimaculatus* sterilized by tepa after semen tagging with radiophosphorus were competitive with untreated males for mates among untreated females. (Auth.)

287 Hölldobler, B. UNTERSUCHUNGEN ZUM VERHALTEN DER AMEISENMÄNNCHEN WÄHREND DER IMAGINALEN LEBENSZEIT. (The behaviour of male ants during their imaginal life span). *Experientia* *20*, 6 (1964) 329-30. (In German, with English summary)

Several phases in the imaginal life of males were identified: I = social phase; II = rest phase; III = sexual phase; and IV = death phase. ^{32}P and ^{131}I were used to study their behaviour, and differences in life and phase spans were observed between *Camponotus ligniperda* Latr. and *C. herculeanus* L. on the one hand, and the much shorter-lived *Formica polyctena* on the other.

Formica also proved much more independent on emergence, and more specifically adapted for the sexual phase. Various other differences were observed.

See also:

5 Three experiments with *Cryptorrhynchus lapathi* L. by means of radioactive marking. (Dafauce, C. et al., 1963)
9 Labelling of eggs of the carob moth, *Ectomyelois ceratoniae* (Zeller), with P^{32} for ecological studies. (Peleg, B.A., Gothilf, S., 1964)
20 A change in the activity of feeding and mobility of the fleas *Xenopsylla cheopis* marked with radioactive phosphorus ^{32}P. (Kharlamov, V.P., 1965)
309 Radioecology of mud-dauber wasps. (Shinn, F., 1964)
318 Swarming, mating, and density in nature of *Anopheles stephensi mysorensis*. (Quraishi, M.S., 1965)
989 Activities of the medfly investigation section July 10, 1963-June 30, 1964 on insect control by radiation. Oirsa, San Salvador, El Salvador. (Morales, E., nd)

(c) Social Behaviour

288 Kloft, W., Hölldobler, B. UNTERSUCHUNGEN ZUR FORSTLICHEN BEDEUTUNG DER HOLZZERSTÖRENDEN ROSSAMEISEN UNTER VERWENDUNG DER TRACER-METHODE. (The wood-destroying carpenter ant and its importance in forestry, studied by tracer technique). *Anz. Schädlingsk.* *37* (1964) 163-9. (In German, with English summary)

Carpenter ants (*Camponotus* sp.) are known to occur in forests in northern and southern Europe. However, they can also be shown to be a serious menace in Central Europe, as illustrated in a forest at 340 m above sea level in northern Bavaria. Whereas isolated infested trunks may occur throughout an entire forest area, a high percentage of infested trunks was found in sunny and warm marginal zones. In that particular forest the ants appeared to prefer Norway spruce but also settled on pine and, occasionally, on oak, beech, and birch. Damage was primarily caused by *Camponotus herculeanus* L. ^{131}I in solution in honey water was fed to the ants. Regurgitation allowed the nest areas of *Camponotus* colonies to be determined with precision. The nest area of a single colony could be shown to cover several trunks and to be much wider than could be supposed from damage visible externally.

289 Kloft, W., Hölldobler, B., Haisch, A. TRACERUNTERSUCHUNGEN ZUR ABGRENZUNG VON NESTAREALEN HOLZZERSTÖRENDER ROSSAMEISEN (*Camponotus herculeanus* L. UND *C. ligniperda* Latr.). (Radiotracer investigations to determine the nest area of wood-destroying ants (*Camponotus herculeanus* and *C. ligniperda* Latr.) *Entomologia exp. appl.* *8*, 1 (1965) 20-26. (In German, with English summary)

Regurgitation is particularly important in the feeding behaviour of wood-destroying ants. In tests in Germany, radioactive iodine, ^{131}I, in honey-water was fed to colonies of *C. herculeanus*, and a scintillation counter was used to determine the nest area (the area that was radioactive following regurgitation) in trees. The apparatus gave very consistent results with different types of wood. The nest area of a single colony was found to include several trunks and covered a much larger area than the external damage revealed.

290 Montagner, H. COMMENT CARACTERISER LE TRANSIT INTESTINAL CHEZ LES GUEPES SOCIALES. LES CONSEQUENCES BIOLOGIQUES. *C. r. hebd. Séanc. Acad. Sci.*, Paris *259*, 12 (1964) 2016-9.

Les travaux ont porté sur *Paravespula germanica* et *P. vulgaris*. L'auteur a utilisé deux méthodes pour rendre compte de la durée du transit intestinal: 1) La mesure proprement dite de la période biologique, période effectivement mesurée, et 2) Le calcul du rapport radioactivité des excreta/radioactivité des insectes. - Pour une durée d'expérience de 24 h, il apparaît que le rapport est d'autant plus faible que les insectes sont plus nombreux. La rétention intestinale est d'emblée très bonne pour les groupements d'au moins 30 individus, alors que le transit est beaucoup plus rapide pour ceux qui ne comportent que quelques unités. Ce phénomène s'accentue pour une température nettement inférieure à la température sociale du nid, 23°C contre 28°C. Les expériences ont également montré que l'économie de nourriture est la mieux réalisée dans un groupe qui a gardé la structuration sociale la plus proche de la normale. Au contraire, les ouvrières isolées montrent une rétention de nourriture très faible. Variations comparées des périodes biologiques des ouvrières et des mâles montrent le caractère réduit de la vie sociale chez les mâles dont les seules composantes véritables sont la recherche des régurgitations larvaires et l'accomplissement des fécondations.

291 Montagner, H. ETUDE DU COMPORTEMENT ALIMENTAIRE ET DES RELATIONS TROPHALLACTIQUES DES MALES AU SEIN DE LA SOCIETE DE GUEPES AU MOYEN D'UN RADIO-ISOTOPE. *Insectes soc.* *11*, 4 (1964) 301-16.

Le marquage des insectes (*Paravespula vulgaris*) a été effectué en fournissant du miel auquel a été incorporé de l'or radioactif (^{198}Au) en solution colloïdale, de façon que chaque individu puisse absorber au moins l'équivalent de 1 μc. Les auteurs ont montré que les mâles des nids actifs s'alimentaient convenablement d'eux-mêmes, alors que dans les nids avancés les jeunes étaient seuls capables de le faire. Les adultes de ces derniers ont toujours une alimentation faible ou nulle. Les ouvrières ne les nourissent qu'avec réticence. Par contre, ils semblent très aptes à solliciter les régurgitations des larves. Tant que le nid reste actif et bénéficie d'un apport de nourriture abondante, les mâles sont probablement capables de puiser leur propre nourriture à des sources variées, comme les autres habitants. Mais lorsque le nid périclite ou lorsque les fondatrices filles apparaissent, les pourvoyeuses les délaissent au bénéfice des autres ouvrières, des fondatrices et de leur larves. Il semble alors que les mâles n'acquièrent jamais de façon parfaite le mécanisme de la trophallaxie dont les phases complexes deviennent des réflexes entre les ouvrières. Ce sont des individus inadaptés à la vie sociale du nid, n'ayant que peu de relations avec leurs ouvrières et vivant en parasites sur les régurgitations des larves. D'ailleurs, ils ne sont pas capables de nourrir le couvain, même lorsqu'on leur fournit une nourriture abondante et ils s'alimentent seuls.

See also:

277 Sur les échanges du "deuxième degré" entre colonies filles de *Formica polyctena* étudiés au moyen des radio-isotopes. (Chauvin, R., Lecomte, J., 1964)
287 The behaviour of male ants during their imaginal life span. (Hölldobler, B., 1964)

(d) Dispersal and Migration

292 Dlabola, J., Taimr, L. THE DISPERSAL FLIGHT OF *Meligethes* BEETLES AND SPRING MIGRATION OF DELPHACIDS WITH SPECIAL REFERENCE TO THE APPLICATION OF THE TRACER METHOD. p. 328 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul. 1964". Freeman, P., Ed. London, Royal Entomological Society of London, 1965.

Radioisotopes were first used in Czechoslovakia for work on the ecology of the leafhopper *Javesella pellucida* Fabr., the vector of oats sterile dwarf virus, to study its migration from hibernation to spring oats. Other experiments were carried out with bees to test their effectiveness in visiting alfalfa flowers and with *Meligethes* beetles visiting rape flowers. A solution of $Na_2H^{32}PO_4$ or $NaH_2{}^{32}PO_4$ of specific activity 50-150 μCi/ml labelled the plant sap. Leafhopper activity reached 100-1000 cpm, ensuring adequate detection up to 4 weeks of capture. Pollinators were marked by feeding on honey and sugar paste to which water was added, mixed with $H_3{}^{32}PO_4$ (50 μCi/ml) but no positive result was obtained in alfalfa fields. *Meligethes* beetles were dipped (aqueous solution of $H_3{}^{32}PO_4$, at 11.7 μCi/ml, for 4 min). The detection of radioactive specimens after 8 d exposure was secured by gluing them on a safety pack x-ray film, thus permitting differences of 5 cpm to be measured. Only one labelled female was found in the oat field of release, and one male specimen about 500 m to the south east. The following year about 17 000 labelled specimens were released at their hibernation site and checked at successive weekly intervals. Of 5572 specimens swept only eight were radioactive. Maximum migration from the point of release was 824 m to the south east (the prevailing wind direction), with an evident spread over an area exceeding 2-3 km in diameter, because no strikingly higher number of radioactive specimens had been found in fields closest to the point of release. The marked 138 000 *Meligethes* spp, predominantly *M. aeneus* F., were released some metres from the flowering rape. The speed of flight of the beetles was 150 m/h. 85 samples swept after 1, 50 and 98 h contained 465 labelled specimens out of 131 300, showing the dispersal to be nearly regular over the area. In a second experiment 483 000 specimens were marked, in a different area, near a wood in the centre of some distant fields of rape. In the nearest field (200 m away), labelled beetles were found 2 h after release. A sweep in all three fields within a circle of one km in diameter 24 h later gave an average of 26 labelled specimens in 25 000 beetles checked. Similar sampling 8 d later at about 4.3 km gave an average of 10 specimens. The radius of action and mobility of flying insects appears to be much higher than previously supposed, so that the actual maximum distance of migration can hardly be ascertained either by means of a portable detection apparatus or by sweeping.

293 Dustan, G.G. TAGGING THE ORIENTAL FRUIT MOTH, Grapholita molesta (Busck) WITH RADIOACTIVE PHOSPHORUS FOR FLIGHT AND DISPERSAL STUDIES. Can. Ent. 97, 8 (1965) 810-16.

Large numbers of Oriental fruit moth adults were successfully tagged (500 or more cpm) by holding them for 24-48 h in cages provided with cotton wicks moistened with a water-solution of ^{32}P at 20 µCi/ml. The addition of sugar to the tagging solution did not increase its effectiveness. Approximately 80% of the total radioactivity of the tagged moths was internal due to ingested liquid and the remainder was on the surface of their bodies; 73% of the total was in and on the abdomen. The loss in radioactivity of tagged moths in 1-6 d was 2.2-4.7 times greater than the theoretical loss due to isotope decay alone. The highest rate of loss occurred during the first day, probably through excretion before the ^{32}P was absorbed from the digestive tract. Egg laying contributed to loss of radioactivity. Though water and liquid bait removed some ^{32}P from tagged moths this did not result in appreciable contamination of other moths trapped in the liquids. Attempts to tag large numbers of moths (400-1000 per cage) for release and recovery experiments were only partially successful as the radioactivities attained by individual moths varied widely at different times and from cage to cage, even under the same environmental conditions. This appeared to be partly due to differences in the feeding behaviour of different batches of moths and it may have been influenced by the conditions under which they were reared. (Auth.)

294 Fussell, E.M. DISPERSAL STUDIES ON RADIOACTIVE-TAGGED Culex quinquefasciatus Say. Mosquito News 24, 4 (1964) 422-6.

$H_3{}^{32}PO_4$ was used for labelling larvae at 0.079 mCi ^{32}P/l water, at a larval concentration of 4000 larvae/ft^2 water surface. Previous studies had shown the Waipio Peninsula to be the primary source of C. quinquefasciatus for the Pearl Harbor area. Out of 275 000 labelled mosquitoes released on the peninsula 634 were recovered at distances up to 3.5 miles and 20 beyond the 0.5 mile radius of the release point. Whereas wind direction had some effect, dispersal distance was not affected by the sex of the mosquito.

295 Impens, R., François, E., Riga, A. Myzus persicae Sulz. ET Aphis fabae Scop.; LEUR DISPERSION SUIVIE A L'AIDE DE ^{32}P. Revue Agric., Brux. 17, 7/8 (1964) 905-19. (With English summary)

Ces essais ont été menés au cours de l'année 1963. Un procédé de marquage d'aphides au moyen de ^{32}P et de comptage de l'activité absorbée par ceux-ci est décrit. Des betteraves cultivées en vases de végétation, furent arrosées avec une solution contenant 1 mCi de ^{32}P (solution à laquelle avait été ajoutée une certaine quantité de ^{32}P stable sous la même forme chimique d'orthophosphate). Les pucerons restèrent 2 ou 3 j sur les plantes radioactives. Les essais principaux, en plein champ, sur des parcelles de betteraves sucrières, furent conçus de manière à pouvoir étudier la dispersion des deux pucerons virulifères: Aphis fabae Scop. et Myzus persicae Sulz. L'utilisation d'un appareil de détection à grande sensibilité et à faible mouvement propre a permis de mesurer les activités, quelquefois très faibles, de la fraction des insectes capturés provenant des plantes-sources marquées. Les résultats sont encourageants. Des précisions sont apportées sur l'écologie des deux pucerons. .

296 (2) Łęski, R. STUDIA NAD BIOLOGIĄ I EKOLOGIĄ NASIONNICY TRZEŚNIÓWKI Rhagoletis cerasi L. (DIPT., TRYPETIDAE). (Studies on the bionomics and ecology of Rhagoletis cerasi L.). Polskie Pismo ent. B, Pt. 3-4 (1963) 153-240. (In Polish, with English and Russian summaries)

^{32}P was used in some attempts to determine the duration and range of adult flight but was found to be unsuitable as the tracer was transmitted to eggs and larvae by the female, and cherries became contaminated.

297 Lewis, C.T., Waloff, N. THE USE OF RADIOACTIVE TRACERS IN THE STUDY OF DISPERSION OF Orthotylus virescens (Douglas and Scott) (MIRIDAE, HETEROPTERA). Entomologia exp. appl. 7, 1 (1964) 15-24. (With French summary)

A method is described by means of which large numbers of O. virescens captured on broom (Sarothamnus scoparius) in England were labelled with ^{32}P and ^{35}S that could be readily differentiated autoradiographically. Samples of insects labelled differently were released in two sections of the broom plantation, and subsequent recaptures from inside and outside the plantation provided evidence of a considerable edge effect of the habitat on the movement of the Mirids. (From auth. summary)

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299 Quraishi, M.S. STUDY OF THE FLIGHT RANGE AND GONOTROPHIC CYCLES IN Anopheles stephensi USING P^{32}. p. 426-28 of "The Role of Science in the Development of Natural Resources with Particular Reference to Pakistan, Iran and Turkey. Symposium of the Cento Scientific Council, Lahore, Jan. 1962". Oxford, Pergamon Press 1964, 454p.

Over the last two years, field studies were carried out, in collaboration with the Iranian Institute of Malariology and Parasitology, in which a total of 190 000 ^{32}P-labelled A. stephensi were released among a group of isolated villages. After large-scale collection 287 labelled insects were recaptured at distances up to 4½ km from the release point. All captured females were classified according to the amount of undigested blood (Sella stage) and then dissected to find the stages of development of their ovaries (Christopher's stage). The number of dilations in the ovarioles revealed the number of gonotrophic cycles completed by the females (Polovodova). The study thus provides an effective determination of the flight range, the development of the ovaries in relation to the age of the mosquito and the length of the gonotrophic cycle on nature.

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301 Rubtsov, I.A. MODE AND RANGE OF BLACK FLY (DIPTERA: SIMULIIDAE) LARVAL MIGRATIONS. Ent. Obozr. 43, 1 (1964) 52-66. (In Russian). English Translation: Ent. Rev. 43, 1 (1964) 27-33.

Migration of the blackfly was studied by direct visual observation of larval displacement in bodies of water; clearing (e.g. by insecticides) sectors of water below sites where mass concentrations have been found and then studying the colonization of the cleared sections; tagging larvae with radioisotopes, then releasing them into the water, recovering them and counting the tagged specimens; observation of the distribution of larvae and pupae in drained riverbeds after the spring floods have subsided; and other indirect methods. Difficulties in recovering tagged insects under natural conditions make a valid interpretation of results almost impossible, particularly assessments of the distance to which larvae are actually able to migrate.*

302 Soria, F. STUDIES ON THE LONG-RANGE DISPERSION OF THE MEDITERRANEAN FRUIT FLY UNDER VARIOUS CONDITIONS IN TUNISIA. WP/31/7, International Atomic Energy Agency, Vienna (Austria). 1965, p. 4.

303 Stern, V.M., Schlinger, E.I., Bowen, W.R. DISPERSAL STUDIES OF Trichogramma semifumatum (HYMENOPTERA: TRICHOGRAMMATIDAE) TAGGED WITH RADIOACTIVE PHOSPHORUS. Ann. ent. Soc. Am. 58, 2 (1965) 234-40.

About 2 million T. semifumatum (Perkins) were released in the first study, in the Imperial Valley, Calif., and about 1½ million in a second study near Shafter, Calif., in 1960. Females tended to disperse more rapidly than males, 1 ♀ being recovered 2000 ft from the release point 17 h after release, while 2 ♂ were taken 400 ft from the release point after another 24 h had elapsed. One individual (sex not determined) was recovered 3500 ft from the release point, 62 h after release. Since the radioactive wasps were found to live at least 15 d after release, females could have dispersed up to 10 miles and males up to 1 mile of they dispersed unidirectionally from the area of release or emergence. Specimens were easily recovered within 200 ft of the release point, but the factor of area dilution is extremely important in connection with recovery of tagged specimens, whose number decreased markedly with increased distance. In the absence of rigorous weather

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* see I/334.

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conditions, the extent to which temperature and wind aided or hindered dispersal could not be determined. Tagging procedures and vacuum suction sampling methods are discussed. ^{32}P was administered in a honey-water solution (2/3 honey and 1/3 water), smeared on glass plate tops to feed and tag the parasites as they emerged and flew towards the light (being positively phototropic). Many of the parasites ingested enough radioactive honey-water to give 1500 cpm on a G-M scaler.

304 Taimr, L., Dlabola, J. RADIOISOTOPES AS TRACERS USED FOR MIGRATION STUDIES OF THE LEAFHOPPER SPECIES Caligypona pellucida F. Acta agron. hung. 12, 3/4 (1963) 321-34. (In Hungarian)

See also:

1 Radiomarking in the study of insect pests. (Andreev, S.V. et al., 1964)
2 Labelling of adults of Chilo partellus Swinhoe. (C. zonellus), the stalkborer of maize and "Jowar", with radioactive phosphorus (P^{32}). (Chatterji, S. et al., 1964)
6 Three techniques for labelling Culicoides (Diptera: Heleidae) with radioactive tracers both in the laboratory and in the field. (Davies, J.B., 1965)
9 Labeling of eggs of the carob moth, Ectomyelois ceratoniae (Zeller), with P^{32} for ecological studies. (Peleg, B.A., Gothilf, S., 1964)
272 The bionomics of blow flies. (Norris, K.R., 1965)
282 Relation of distance to foraging intensity of honey bees (Apis mellifera) on natural food sources. (Lee, W.R., 1965)
318 Swarming, mating, and density in nature of Anopheles stephensi mysorensis. (Quraishi, M.S., 1965)
319 Les radioisotopes in écologie animale: I. Expériences sur le marquage de pucerons vecteurs de la jaunisse de la betterave. (Impens, R. et al., 1965)
988 The application of nuclear energy to agriculture. (Moh, C.C., 1964)
989 Activities of the medfly investigation section during July 10, 1963 - June 30, 1964 on insect control by radiation. OIRSA, San Salvador, El Salvador. (Morales, E., nd)

3. Inter-Relations

(a) Insect Environment
(Radioactive Contaminated Systems, including Deliberate Contamination and Fallout, and Food Chains)

305(2) Crossley, D.A., Jr. LANDSCAPE STUDIES USING RADIOACTIVE TRACERS: III. INTERDEPENDENCE BETWEEN ARTHROPOD FOOD CHAINS IN A TULIP POPLAR FOREST. Bull. ecol. Soc. Am. 44, 3 (1963) 74. Abstr.

The contrasting movements of ^{137}Cs through two types of food chains is being followed in a tulip poplar stand. One food chain was based on green foliage. The principal herbivores were geometrid larvae and aphids; principal predators were chrysopids and spiders. The other food chain was based on litter. Distribution of ^{137}Cs in plants, herbivores and predators was similar to that found for the soil-plant-insect food chain on the White Oak Lake bed. Concentrations of ^{137}Cs in leaf litter herbivores, and predators collected from the forest floor, suggest that some of the forest floor animals meet their energy requirements through the green foliage food chain. Current research is using physical and biological aspects of the movement of ^{137}Cs to define more precisely the interactions between food chains based on different parts of the ecosystems. (Abstr.)

306 Nelson, D.J. BIOLOGICAL VECTORS AND RESERVOIRS OF STRONTIUM-90. Nature, Lond. 203 (1964) 420.

The roles of emergent Chironomidae as vectors of ^{90}Sr and freshwater clams as reservoirs of ^{90}Sr in the Clinch and Tennessee Rivers were assessed. Fallout entering the Clinch River added 45 times as much ^{90}Sr as was removed by the emerging chironomids. Therefore, it was concluded that the general dispersion of ^{90}Sr by insects is not of great importance. Similarly, the annual removal and reservoir of ^{90}Sr in clams were small. It is suggested that general contamination of the landscape by mobile organisms is unlikely. (NSA 18: 1964, 36918)

307 Patten, B.C. STATIONARY DISTRIBUTION AND TURNOVER OF RADIOACTIVITY IN A HYPOTHETICAL FOOD CHAIN. p. 90-92 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p.

A mathematical approach is described.

308 Rickard, W.H., Haverfield, L.E. PITFALL TRAPPING SURVEY OF AUTUMN-EMERGING DARKLING BEETLES IN DESERT STEPPE VEGETATION. HW-SA-3556, General Electric Co., Richland, Wash. Hanford Atomic Products Operation. 28 May 1964, 17p.

A continuous pitfall trapping survey of the autumn-emerging darkling beetles, Pelecyphorus densicollis Horn. and Stenomorpha puncticollis LeC., was made in adjacent greasewood and sagebrush communities on the Hanford Reservation, Benton County, Wash. in 1963. 49 pitfall traps arranged in a 7 × 7-m grid pattern with regular 3-m spacing were located in each community and visited at 3-4 d intervals. Pelecyphorus emerged slightly earlier than Stenomorpha but both species persisted until the first measured snowfall in early December. A total of 4378 beetles were captured, marked, and released. Beetles of the greasewood community tended to be higher in cations than those of the sagebrush community, especially with respect to Na. A comparison of the γ-emitting radionuclide content derived from worldwide fallout of vegetation and darkling beetles was made in the summer of 1962 (Table IV). Cerium-praseodymium-144, zirconium-niobium-95, and ruthenium-rhodium-106 were the most abundant γ-emitting radionuclides measured in the leaves, with very small amounts of ^{137}Cs. No accumulation from fallout was observed in darkling beetles. Some accumulation might be expected because of the high potassium content in beetles, and since ^{137}Cs is somewhat similar to K in chemical behaviour.

309 Shinn, A.F. RADIOECOLOGY OF MUD-DAUBER WASPS. Bull. ent. Soc. Am. 10, 3 (1964) 172. Abstr.

Sceliphron but not Trypoxylon mud-daubers used radioactive mud from liquid waste disposal areas for nest construction. Comparisons of adult emergence and parasites are given for radioactive and control nests of Sceliphron. Experiments for determination of dispersal after hatching, flight range, and radiation dose to free-living adult wasps are discussed.

310 Shinn, A.F., Dodson, G.J., Corley, C.L. TRANSPORT OF RADIOACTIVE MATERIALS BY MUD-DAUBER WASPS. p. 71-3 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct. 1964.

The Black-and-Yellow mud-dauber wasps, Sceliphron cementarium, construct nests using radioactive mud from waste pits and the White Oak Lake bed. The Pipe-Organ mud-dauber wasp, Trypoxylon politum, common in the same areas, never uses radioactive mud. Mud is usually carried to the nest site from < 150 ft away but may be carried up to 650 ft. A short flight range is indicated. Several species of wasps, beetles, and flies use the mud nests of Sceliphron as parasites or tenants. The effect of the radiation on Sceliphron is to reduce successful emergence by a significant 40% ($P < 0.001$), and radioactive cells of the nests show a higher mortality from parasites ($P < 0.01$). Radioactive nests gave survey meter readings from slightly above background to > 1 R/h of mixed γ- and β-radiation, but neither spiders stored as food nor developing wasps were radioactive. ^{137}Cs, ^{106}Ru, ^{60}Co, ^{65}Zn, ^{144}Ce, and ^{90}Sr were identified in the nest as γ- and β-emitters, respectively. The total dose received by developing wasps was 10 630 rad: 110 rad to the eggs (3 d), 520 rad to the larvae (14 d), and 10 000 rad to the overwintering larva in its cocoon (9 months). The Sceliphron population will decline.

311 Wiegert, R.G., Odum, E.P., Marples, T.G. USE OF PHOSPHORUS-32 TO ISOLATE FOOD CHAINS IN INTACT ECOSYSTEMS. p. 87-92 of "Onsite Ecological Research of the Division of Biology and Medicine at the Savannah River Ecology Laboratory". TID-21713. Jan. 1965, 93p.

By labelling two different species of plants, Leptilon candensis (horseweed) and Heterotheca subaxillaris (camphorweed) with ^{32}P in the stand containing these among other species revealed striking differences in the transfer of P through the food chain. Phytophagous insects became much more highly labelled on Heterotheca as compared with Leptilon, especially during the first 2 weeks. Heterotheca is clearly "grazed" to a greater extent than Leptilon. The small ant, Dorymyrmex, on the other hand showed a much higher activity density on Leptilon; these ants are believed to feed extensively on plant exudates or natural "honeydew". The uptake pattern in the abundant green cricket (Oecanthus) at first had a much higher activity density in the populations on Heterotheca and then, after the 4th week, a much higher one on Leptilon. In general, small, active ants (e.g. Crematogaster in marsh or Dorymyrmex in old fields) are the first animals to reach peak activity following a single labelling dose applied within the plant tissues. Active grazing herbivores such as plant bugs (Trygonotylus) fulgoris (Prokelisia) or grasshoppers (Orchelimum) may reach a peak within 2-3 weeks while predators such as spiders (Arachnida) do not usually become highly labelled until 40-60 d after plant labelling.

See also:

316 Measurement of heterotrophic productivity with radioactive tracers. (Crossley, D.A., Jr., 1964)
940 Clinch river and related aquatic studies. (Nelson, D.J. et al., 1964)
952 Radiation ecology. (Auerbach, S.I., 1965)
953 Radioactive waste area and radiation effects studies. (Auerbach, S.I. et al., 1964)

(b) Insect-Microorganism

312 Fast, P.G., Angus, T.A. EFFECTS OF PARASPORAL INCLUSIONS OF Bacillus thuringiensis VAR sotto ON THE PERMEABILITY OF THE GUT WALL OF Bombyx mori LARVAE. J. invertebrate Path. 7, 1 (1965) 29-32.

The effects of toxin from B. thuringiensis var sotto on the permeability of gut wall of B. mori larvae were studied using radioactive tracers. The toxin inhibited the transfer of glucose-U-^{14}C into the haemocoel, while transfer of labelled Na_2CO_3 was accelerated. Both effects were greater in the German White strain of B. mori than in the British Zebra strain. The results support the hypothesis that the general paralysis observed in the insect is due to changes in the haemolymph pH induced by altered gut wall permeability. (CA 63:1965,976)

313 Geesteranus, H.P.M. TITER DETERMINATION OF PREPARATIONS OF Bacillus thuringiensis Berliner. Entomophaga 10, 1 (1965) 27.

Bacterial suspensions were mixed with ^{32}P and spread on leaves on which 3rd-instar larvae were placed subsequently. First symptoms of intoxication were cessation of feeding and excretion of faeces. At concentrations which caused a mortality of 70-80% after 36 h, the dead caterpillars could be divided into two groups, according to high or low radioactivity, depending on experimental conditions. These differences are caused by the fact that the different toxins in the preparations react on different parts of the intestinal tract. A caterpillar of low radioactivity had reacted to the thermostable, water-soluble toxine, inducing a feeding stop in the first part of the gut system. A caterpillar with high radioactivity had not reacted to this exotoxin, but had stopped feeding at the moment of food entering the midgut, induced by crystals. An indication of the ratio of these two toxins in commercial preparations of these insect pathogenic bacteria is therefore given.

(c) Insect-Animal
(including Parasites and Predator Relationships)

314 James, H.G. PREDATORS OF Aedes atropalpus (Coq.) (DIPTERA: CULICIDAE) AND OF OTHER MOSQUITOES BREEDING IN ROCK POOLS IN ONTARIO. Can. J. Zool. 43, 1 (1965) 155-59.

Predators of A. atropalpus (Coq.) and of other rockpool mosquitoes (Culex restuans Theob., C. territans Walk., and Anopheles punctipennis (Say)) were investigated at Cordova Mines, Ont., by tagging larvae with radioactive phosphorus, ^{32}P. ^{32}P in the form of $H_3{}^{32}PO_4$ was added to bring the radioactivity of the rearing medium to 0.25 μCi/ml. Under the experimental conditions the average cpm for the 11 sample larvae was 63 440 (range 9 820-186 000) above background. High radiation counts showed that six species of dytiscids, two of Hemiptera, a leech, and a minnow were predators of A. atropalpus. The dytiscid Laccophilus maculosus Germ. exceeded other arthropod predators in numbers and in degrees of radioactivity. Hydra oligactis Pallas killed but did not ingest the tagged larvae. Other evidence suggested that H. oligactis inhibits breeding by capturing young larvae and paralysing later stages. Five species of aquatic insects were predacious on larvae of Anopheles and Culex.

315 Lebez, D., Maretić, Z., Kristan, J. STUDIES ON LABELED ANIMAL POISONS. I. DISTRIBUTION OF ^{32}P-LABELED Latrodectus tredecimguttatus VENOM. Toxicon 2, 4 (1965) 251-3.

Four adult L. tredecimguttatus were used during the summer months. Water was withheld from the spiders for 1 week prior to exposure to drinking water containing $Na_2H^{32}PO_4$. Two to four days later a guinea pig was exposed to one spider, and the distribution of ^{32}P studied in the envenomated guinea pig. Large amounts of ^{32}P were found in the central nervous system and peripheral nerves; small amounts were found in the liver, spleen, lungs, heart, kidneys, adrenals, muscles and blood.

See also:

10 A new method of P-32 labelling of the scale predator, Chilocorus bipustulatus L. (Coccinellidae), with possible application to other scale predators. (Peleg, B.A., Nadel, D.J., 1965)
279 Measurement of salivation by Aedes aegypti (L.) feeding on a living host. (Devine, T.L. et al., 1965)
305 Landscape studies using radioactive tracers: III. Interdependence between arthropod food chains in a tulip poplar forest. (Crossley, D.A., Jr., 1963)

(d) Insect-Plant
(including Forest Infestation)

316 Crossley, D.A., Jr. MEASUREMENT OF HETEROTROPHIC PRODUCTIVITY WITH RADIOACTIVE TRACERS. p.74-5 of "Health Physics Division Annual Progress Report for Period ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct.1964.

Data obtained for the plant - insect herbivore - insect predator food chain on White Oak Lake bed were were used for the estimation of heterotrophic production and energy flow at the herbivore level, by combining information on radiocesium movement and information on biomasses, respiration rates, and caloric content of plants and insects. The equilibrium concentration of ^{137}Cs in predaceous insects (73%/g of dry weight) and an elimination constant corrected for the average size of the population (0.98 d^{-1}) suggest an intake rate of 72%/g dry weight of predator/d. From the average Cs concentration in herbivorous insects (78%/g), the food intake by predators was estimated to be 0.92 g eaten per g of predator/d. An integrated biomass curve indicated this as 630 mg of herbivore consumed/m^2 during the sampling period. Assuming a non-predatory mortality of 20%, total mortality would then be 788 mg/m^2. Total production for the herbivorous insect population during the 9 week sampling period is estimated at 140 mg/m^2 net increase plus 788 mg/m^2 loss to mortality, for a total of 928 mg/m^2 production. Net increase in biomass was only 15% of total production. Energy flow through herbivorous insects was estimated as 33.6 kcal/m^2 maintenance, 10.8 kcal/m^2 production, for a total of 44.4 kcal/m^2, corrected to a 20 week growing season.

317 Williams, M.W., Lindner, R.C. J. Insect Physiol. 11, 1 (1965) 51.

Tests conducted by the authors have shown that when psylla (Psylla pyricola Foerster) are allowed to become radioactive with ^{14}C and transferred to non-labelled pear seedlings, activity appears in the vascular system of the seedlings. This rather conclusively suggests an exchange between the insect and plant. (Unpublished data cited in their article "Biochemical Components of Pear Psylla and their Relative Toxicity to Excised Bean Plants", ibid. 41-52.)

See also:

5 Three experiments with *Cryptorrhynchus lapathi* L. by means of radioactive marking. (Dafauce, C. et al., 1963)

4. Population Dynamics

318 Quraishi, M.S. SWARMING, MATING, AND DENSITY IN NATURE OF *Anopheles stephensi mysorensis*. *J. econ. Ent.* *58*, 5 (1965) 821-4.

Swarm formation and copulation in swarms of *A. stephensi mysorensis* Sweet and Rao were studied. A few females were captured during copulation. They were found not to have fed but some had completed one or two gonotrophic cycles. Female-male ratio in the swarm was 3 : 5, in indoor catches 2.3 : 1, and in pit shelter 1 : 1. Swarm formation (of about 15 000 mosquitoes) was also studied on ^{32}P-labelled insects, when a few ♂ immediately formed swarms of 200-300 individuals. The capture of copulating pairs showed that the unfed ♀ mates immediately after release and before taking a blood meal. Once mated, the ♀ takes her first blood meal during the first night of flight. All labelled ♀ captured within 16 h of release had fed on blood. Both ♂ and ♀ are capable of flying a distance of 4.3 km; they can cover > 1.8 km overnight from the point of release.

See also:

3 The present state of the protection of potato against Colorado beetle in the USSR and the problems involved. (Chigarev, G.A., 1963)
296 Studies on the bionomics and ecology of *Rhagoletis cerasi* L. (Łęski, R., 1963)
302 Studies on the long-range dispersion of the Mediterranean fruit fly under various conditions in Tunisia. (Soria, F., 1965)

5. Life Cycle. Development

See:

3 The present state of the protection of potato against Colorado beetle in the USSR and the problems involved. (Chigarev, G.A., 1963)
296 Studies of the bionomics and ecology of *Rhagoletis cerasi* L. (Łęski, R., 1963)
299 Study of the flight range and gonotrophic cycles in *Anopheles stephensi* using P^{32}. (Quraishi, M.S., 1964)
309 Radioecology of mud-dauber wasps. (Shinn, A.F., 1964)
822 Studies on the rate of spermatogenesis in *Drosophila*: effects of x-rays and streptonigrin. (Martin, A.O., 1965)

D. INSECTS AS DISEASE VECTORS

319 Impens, R., François, E., Riga, A. LES RADIOISOTOPES EN ECOLOGIE ANIMALE: I. EXPERIENCES SUR LE MARQUAGE DE PUCERONS VECTEURS DE LA JAUNISSE DE LA BETTERAVE. *Meded. LandbHoogesch. OpzoekStns Gent* *30*, 2 (1965) 1009-1015.

Les betteraves virosées, couvertes de pucerons, et arrosées au moyen d'une solution d'orthophosphate de sodium marquée au ^{32}P, furent placées au centre de parcelles de betteraves. La radioactivité absorbée par les insectes était suffisante pour permettre leur détection. Cette radioactivité était décelée par autoradiographie. Les captures des insectes marqués se furent surtout à proximité (dans un rayon de 4 m) des plantes radioactives. Des ailés de *Myzus* ont été retrouvés à près de 35 m du point de lâcher. Des essais ont déjà été entrepris pour élucider le rôle d'*Hyperomyzus staphyleae* Koch, comme premier vecteur de la Jaunisse. Une technique originale a été mise au point qui consiste à injecter dans la racine une solution de saccharose ^{14}C. Ces racines sont ensuite placés en cave, au milieu d'un silo. La dispersion des pucerons à partir de ce silo, est suivie en disposant des pièges jaunes à proximité.

See also:

283 Further studies on the feeding habits of aster yellows virus-carrying corn leafhoppers. (Orenski, S.W. et al., 1965)

E. CHEMICAL CONTROL MEASURES

1. General Articles. Surveys

320 Dedek, W. DIE ANWENDUNG RADIOAKTIVER NUKLIDE IN DER CHEMIE DER PFLANZENSCHUTZ UND SCHÄDLINGSBEKÄMPFUNGSMITTEL. (The application of radionuclides in studying the chemistry of compounds for plant protection and pest control). *Atompraxis* *10*, 2 (1964) 65-70. (In German)

Bibliographical review article (253 references) listing studies on insecticides, fungicides, herbicides, and growth regulators, in which radioisotopes had been employed. The isotopes used included ^{32}P, ^{35}S, ^{36}Cl, ^{82}Br, ^{14}C, and ^{3}H.

321 Georghiu, G.P. GENETIC STUDIES ON INSECTICIDE RESISTANCE. *Adv. Pest Control Res.* *6* (1965) 171-230.

Review article. After discussing the determination of the genotype, the author considers the inheritance of resistance (DDT, cyclodienes, organophosphates, and carbamates), dealing primarily with *Musca domestica*, mosquitoes, *Drosophila*, *Stomoxys calcitrans*, and *Blattella germanica*. Negatively correlated insecticides, cross resistance and multiple resistance, and vigour tolerance are also discussed. In some of the studies cited radioisotopes were used but this is not stressed. Mention is made of experiments on the induction of resistance by x-irradiation in *Drosophila* (ref. 773).

322 Hilton, B.D., O'Brien, R.D. INSECTICIDE LABELING: A SIMPLE TECHNIQUE FOR TRITIATION OF AROMATIC INSECTICIDES. *J. agric. Fd Chem.* *12*, 3 (1964) 236-8.

The tritiating technique of Yavorsky and Gorin (J. Am. chem. Soc. 84;1962, 1071) was used to label aromatic insecticides, and the degree of labelling, which varies greatly with different compounds, has been tentatively accounted for. The method is simple and requires little space and no expensive reagents or apparatus. The cost per labelled compound is low, on the average $7.00 for 100 - 200 mg of labelled compound. Activities up to 15.5 mCi/mM were obtained. Amongst the compounds labelled were various carbamates, including Sevin, DDT, Baytex, Co-ral, parathion, and naphthalene.

See also:

1070 Use of isotopes in the food-canning industry. (Mercer, W.A., Ralls, J.W., 1964)

2. Fumigants

Carbon Tetrachloride

323 Aiyar, A.S., Fatterpaker, P., Sreenivasan, A. LIPID METABOLISM IN LIVER INJURY CAUSED BY CARBON TETRACHLORIDE IN THE RAT. Biochem. J. 90, 3 (1964) 558-63.

The increase in liver lipids in rats given CCl_4 is restricted to fatty acids of the acetone-soluble lipids. The phospholipid concentration is significantly decreased. The incorporation of uniformly labelled $[^{14}C_2]$acetate into the fatty acids and cholesterol of liver slices is little affected in the early period (after 3 h) of poisoning with CCl_4, when there is a significant decrease in the specific activity of the phospholipids. The labelling of all these fractions is greatly diminished after 24 h. A significant decrease in oxidation rate of octanoate and of $[1\text{-}^{14}C]$palmitate by liver homogenates from rats given CCl_4 is observable 3 h after administration; activity is considerably impaired after 24 h. Poisoning with CCl_4 results in decreases in plasma albumin and in lipids of plasma lipoproteins even 3 h after administration, followed by a considerable decrease in the lipids of the lipoproteins of the cell sap. An impairment of lipoprotein synthesis and consequently of lipid transport may be the primary cause of the accumulation of lipid in liver injury caused by CCl_4. (Auth. summary)

324 Rubenstein, B., Rubinstein, D. THE EFFECT OF CARBON TETRACHLORIDE ON HEPATIC LIPID METABOLISM. Can. J. Biochem. 42, 9 (1964) 1263-73.

The effect of the administration of varying doses of CCl_4 upon the level of hepatic lipid fractions was investigated. The hepatic cholesterol esters are greatest at low doses of CCl_4, while the hepatic triglycerides and serum transaminase levels continue to rise as increasing amounts of CCl_4 are administered. The amount of liver triglycerides is significantly increased within 2 h after CCl_4 administration, while the hepatic cholesterol ester level and serum transaminase activity are not elevated until 6 h. An increase in the rate of incorporation of intravenously administered acetate-1-^{14}C into hepatic triglycerides occurred within 3 h after CCl_4 treatment, but no increase was noted in cholesterol and cholesterol ester radioactivity until an additional 3 h had elapsed. The treatment of CCl_4-intoxicated rats with phenoxybenzamine, although decreasing necrosis, does not prevent the accumulation of hepatic lipids. Slices of liver from CCl_4-intoxicated animals incorporate acetate-1-^{14}C more rapidly into cholesterol esters and less rapidly into cholesterol and triglycerides than liver slices from control animals. The presence of CCl_4 in the atmosphere above the liver slices from untreated animals induced an increase in acetate-1-^{14}C incorporation into both cholesterol esters and free fatty acids and a decrease in incorporation into cholesterol. The incorporation of radioactivity into triglycerides was not affected. (Auth.)

325 Rubinstein, D., Kanics, L. THE CONVERSION OF CARBON TETRACHLORIDE AND CHLOROFORM TO CARBON DIOXIDE BY RAT LIVER HOMOGENATES. Can. J. Biochem. 42, 11 (1964) 1577-85.

Conditions for the conversion of $^{14}CHCl_3$ and $^{14}CCl_4$ to $^{14}CO_2$ by liver homogenates were determined. The addition of a pyridine nucleotide in either the oxidized or reduced state was required for a significant $^{14}CO_2$ production. This effect was abolished when the homogenate was denatured. Glutathione further increased the activity. The optimum pH for the oxidation of $CHCl_3$ to CO_2 lay between 8.0 and 8.5. The dehalogenation of CCl_4 was relatively insensitive to changes in the pH of the incubation medium. At least two enzymes are probably required for the formation of CO_2 from the chloromethanes, since both the microsomal and soluble fractions of the homogenate are required for activity. Production of CO_2 was inhibited by tetrahydrofolate and p-chloromercuribenzoate. Inhibition by the latter could be overcome by glutathione. The coenzyme requirements suggest that $CHCl_3$ may be reduced to CH_2Cl_2, then successively oxidized to formaldehyde and formic acid. However, the formation of significant quantities of these substances from $CHCl_3$ could not be demonstrated. Inhibition of formic acid oxidation did not affect the production of $^{14}CO_2$ from $^{14}CHCl_3$. Radioactivity from $^{14}CHCl_3$ was found in the protein of the homogenate. (Auth.)

326 Weldon, P.R., Rubenstein, B., Rubinstein, D. THE DIRECT ACTION OF CCl_4 ON THE METABOLISM OF LIVER SLICES. Can. J. Biochem. 43, 6 (1965) 647-59.

A manometric study was made of the effect of varying amounts of CCl_4 on the metabolism of glucose, galactose, leucine, acetate, and palmitate by rat liver slices. At concentrations of 0.4-3.3 mg/g of liver, CCl_4 produced a decrease in $^{14}CO_2$ production from succinate-2,3-^{14}C and glucose-6-^{14}C, but not from glucose-1-^{14}C. The presence of CCl_4 did not appreciably affect CO_2 production from glucose-U-^{14}C or galactose-1-^{14}C but stimulated incorporation of the monosaccharides into glycogen at the lower concentrations (1 mg/g). Higher concentrations of CCl_4 (2 mg/g liver) inhibited glycogen synthesis. In this instance the activities of glycogen synthetase and phosphorylase were decreased, but amylase activity and the level of glucose-6-phosphate in the liver slices remained unchanged. The oxidation of palmitate-1-^{14}C and acetate-1-^{14}C to $^{14}CO_2$ was decreased at the higher concentrations of CCl_4, and lipogenesis from acetate was stimulated by lower concentrations of CCl_4. Esterification of palmitate was unaffected by CCl_4. Apparently the function of the tricarboxylic acid cycle is altered by CCl_4 with the result that acetate may be shunted into fatty acids. It is concluded that CCl_4 affects hepatic metabolism in vivo directly. (CA 63:1965, 4852d)

327 Zatti, M., Rossi, F., Zoppi, G. LIVER PHOSPHOLIPIDES AFTER CARBON TETRACHLORIDE INTOXICATION IN RATS. Experientia 21, 4 (1965) 215-6. (In English)

Already 80 min after CCl_4 administration ^{32}P-labelled lysolecithin increased markedly in liver extracts, whereas the incorporation of ^{32}P into phosphatidic acid diminished greatly. The specific activity of the latter was lowered, indicating a block in the synthesis of the compound. The precociously increased incorporation of ^{32}P into lysolecithin corresponds to the initial stage of transiently increased specific activity of the liver phosphatide.

Hydrogen Cyanide

328 Strobel, G.A. HYDROCYANIC ACID ASSIMILATION BY A PSYCHROPHILIC BASIDIOMYCETE. Can. J. Biochem. 42, 11 (1964) 1637-9.

An unidentified psychrophilic basidiomycete is known to incite winter crown rot of alfalfa and other forage crops. The distribution of ^{14}C after the administration of 20 μCi of $H^{14}CN$ was analysed in the amino acid, organic acid, and neutral fractions. The particular psychrophilic basidiomycete proved clearly capable of fixing the C-atom of $H^{14}CN$. In the amino acid fraction most of the radioactivity was associated with alanine, with considerably less labelling in glutamate. At least 80% of the radioactivity in alanine appeared to be associated with the C-atom of the carboxyl group. Inasmuch as no radioactivity was associated with either asparagine or ß-cyanoalanine, it is clear that the mechanism of cyanide assimilation in the organism differs from that proposed for higher plants.

Naphthalene

329 Philleo, W.W., Schonbrod, R.D., Terriere, L.C. METHYLENEDIOXYPHENYL COMPOUNDS AS INHIBITORS OF THE HYDROXYLATION OF NAPHTHALENE IN HOUSEFLIES. J. agric. Fd Chem. 13, 2 (1965) 113-5.

Hydroxylation by house fly microsomes, using naphthalene-1-^{14}C as substrate, has been tested as a possible site of action of the pyrethrin synergists. Five commercial and nine non-commercial compounds containing the methylenedioxyphenyl structure were inhibitory of this process. Inhibitory concentrations range from 10^{-2}M for piperonylic acid to 10^{-5} M for safrole and isosafrole. Of the commercial synergists, piperonyl cyclonene is the most potent inhibitor of microsomal hydroxylation. The commercial synergists, sesamex, sulphoxide, piperonyl butoxide, and n-propyl isome, and the non-commercial compounds, safrole, isosafrole, and piperonal, were found to be synergistic with naphthalene in in vivo tests with female house flies. (Auth.)

330 Meikle, R.W. THE FATE OF SULFURYL FLUORIDE IN WHEAT FLOUR. J. agric. Fd Chem. 12, 5 (1964) 464-7.

The chemical fate of sulphuryl fluoride absorbed by graham flour has been studied. Graham flour was exposed to sulphuryl-^{35}S fluoride and, after suitable fractionation, the protein fraction was found to be responsible for almost all of the decomposition of the absorbed fumigant. Some sulphate was formed. Fluoride, as a consequence of the decomposition of sulphuryl fluoride, is likewise present. (Auth.)

3. Halogenated and Other Hydrocarbons

BHC (Benzene Hexachloride)

331 Koransky, W., Ullberg, S. DISTRIBUTION IN THE BRAIN OF BENZENE HEXACHLORIDE-^{14}C; AUTORADIOGRAPHIC STUDY. Biochem. Pharmac. 13, 11 (1964) 1537-8.

Autoradiograms of sections through the whole head of rats injected with benzene hexachloride-^{14}C intraperitoneally showed that after 24 h the radioactivity was almost exclusively located in white matter. How this occurs is not known. (CA 62:1965, 5823b)

332 Koransky, W., Portig, J., Vohland, H.W., Klempau, I. ACTIVATION OF MICROSOMAL ENZYMES BY HEXACHLOROCYCLOHEXANE ISOMERS. EFFECT ON SCILLIROSIDE POISONING IN RATS. Nauyn-Schmiedebergs Arch. exp. Path. Pharmak. 247, 1 (1964) 61-70. (In German)

Determination of the rate of oxidation of III shows that the activating effect lasts 2 weeks after II, 4 weeks after I, and 8 weeks after administration of β-hexachlorocyclohexane. The narcotic effect of the barbiturate is diminished during activation. Administration of 0.4 mg scilliroside (IV)/kg to treated animals eliminated the typical convulsions occurring after 16-24 h. The development, intensity, and duration of IV tolerance parallel the activation. The enzyme activators phenobarbital, phenylbutazone, nikethamide, and Luminal also produce tolerance. Enzyme inhibitor CFT 1201 (Neubert and Gerken, CA 51, 16927d) abolished the IV tolerance produced by the 3 isomers or the activators. Ethionine (Kato et al., CA 57, 2795d), 200 mg/kg, inhibited the resistance produced by II and Luminal. Therefore, it is believed that the tolerance is due to the activation of microsomal enzymes. (CA 61:1964, 13818c)

333 Koransky, W., Portig, J., Vohland, H.W., Klempau, I. ELIMINATION OF α- AND γ-HEXACHLOROCYCLOHEXANE AND THE EFFECTS OF LIVER MICROSOMAL ENZYMES. Nauyn-Schmiedebergs Arch. exp. Path. Pharmak. 247, 1 (1964) 49-60. (In German)

Female rats were injected intraperitoneally with 2% α- or γ-hexachlorocyclohexane-^{36}Cl oxide (I and II, respectively) in oil, (100 and 40 mg/kg, respectively), and the excretion was determined over 40 d. Only 75-80% of the total radioactivity was excreted, 80% of which was eliminated in the urine and 20% in the faeces. Of the urinary activity, 60% was found in Cl^- and 40% in chlorinated organic compounds, the latter being greater just after administration. II was eliminated faster than I. Pretreatment with phenobarbital accelerated the elimination; organic metabolites increased, while $^{36}Cl^-$ decreased. A dose of 200 mg I/kg reduced the narcotic effect of hexobarbital (III) and Eunarkon during four weeks, while in vitro the oxidation of III by microsome preparations was accelerated. It is assumed that I and II are strong activators of the oxidizing enzymes of the liver microsomes which meanwhile serve as catalysts in the oxidative transformation of the mols. (CA 61:1964, 13818a)

334 Sieber, K., Jumar, A., Grosse-Ruyken, H. DETERMINATION OF THE CONTENT OF γ-HEXACHLOROCYCLOHEXANE IN TECHNICAL SAMPLES BY USING ISOTOPE DILUTION WITH ^{36}Cl. Chem. Tech., Berl. 16, 4 (1964) 222-5.

A method for the determination of γ-hexachlorocyclohexane (I) in technical I was elaborated by dilution with lindane containing ^{36}Cl as indicator, which is superior to using ^{2}H and ^{11}C. Add to the sample 120 mg of ^{36}Cl marked I and melt very carefully on a gas flame. Then add 2 ml MeOH and keep for 30 min at 40° C. Separate the mother liquor from the residue and cool the former for 30 min in a 20°C bath (a part of the extracted I). Dissolve the precipitate in 0.3 ml 96% EtOH at 40°C and precipitate again by cooling to 20°C. To obtain a very pure substance recrystallize first from a 1:1 mixture of 2,4-dioxane:BuOH and later from 0.2 ml EtOH. Dry at 70°C for 1 h. The yield is about 25 mg. Measure the activity with a counter and calculate the amount of I. Optimum conditions for the preparation of the ^{36}Cl-containing I are given in detail starting from a Na^{36}Cl sample with an activity of 40 μCi/g, which results in ^{36}Cl-I with an activity of 0.9 μCi/g. (CA 61:1964, 7707c)

335(1) Torii, T. PENETRATION AND TRANSLOCATION OF γ BHC TOPICALLY APPLIED TO SOME PLANTS WITH INSECT GALLS. (A SUPPLEMENT TO AND GENERAL CONSIDERATIONS ON STUDIES ON THE BIOLOGICAL CONTROL OF THE CHESTNUT GALL WASP). J. Fac. Agric. Shinshu Univ. 2, 3 (1960) 161-90.

Females of parasites of Dryocosmus kuriphilus Yasumatsu on chestnut [Castanea crenata] in Japan emerge in early summer. They oviposit in larvae and pupae of the Cynipid in the galls of the generations in which they themselves developed and also in other species of gall insects. One possible method of controlling D. kuriphilus is to apply γ BHC to the galls so as to kill the emerging Cynipids, but this may harm the parasites. Experiments on the extent to which γ BHC penetrates plants tissues were therefore carried out in the laboratory; ^{14}C-γ BHC was used. Emulsified solutions were applied topically to various parts of cut, gall-bearing plants, including chestnut. Insecticide was absorbed to a certain extent when applied to most tissues and translocated, presumably in the phloem. Applied to chestnut galls, however, the insecticide did not penetrate more than ~0.5 mm beneath the surface and did not injure insects inside the galls. As its action was limited in time, it appeared suitable for control of the Cynipids if applied at the optimum period for control, i.e. ~20 d after the emergence of the first parasite adults, and 10 d after D. kuriphilus. In the Ina district, it could be determined from galls collected between 15 - 20 June. (From RAE-A 53:1865, 366-7)

Aldrin. Dieldrin

336 Crothers, W.C., Forgash, A.J. STUDIES ON THE RATE OF PENETRATION OF DIAZINON, DIELDRIN AND MALATHION IN RESISTANT AND SUSCEPTIBLE M. domestica. Bull. ent. Soc. Am. 10, 3 (1964) 163. Abstr.

The cuticular penetration rate of ^{14}C-labelled diazinon, dieldrin, and malathion of one susceptible and five resistant strains of house flies was investigated. Results indicate the insecticides penetrate the cuticle of that strain more rapidly than the resistant strains at various exposure times.

337 Gerolt, Ph. THE FATE OF DIELDRIN IN INSECTS. J. econ. Ent. 58, 5 (1965) 849-57.

Use was made of ^{14}C-dieldrin, randomly labelled in the hexachlorocyclopentadiene moiety. Under normal physiological conditions the rates of penetration of dieldrin into S - and into R-flies, Musca domestica L., are similar, but in S-flies this rate becomes reduced coincident with the onset of symptoms of excitation. At the same time, the haemolymph of dieldrin-intoxicated flies becomes very much dehydrated and the intestines are swollen with fluid, a phenomenon also occurring with insecticides not related to dieldrin. Translocation of sublethal amounts of dieldrin via the legs to other body parts is similar in S-and R-flies. After a limited period of tarsal exposure to the toxicant, a concentration equilibrium is reached in the body within 2-3 h, the final distribution then being approximately: legs 5%, head 9%, thorax 22%, wings 1%, and abdomen 63%. The insecticide is less concentrated in the tissues of thorax and legs than in the head and abdomen, but there is also no difference between S- and R -flies in this respect. House flies converted only 10% of a sublethal dose into more hydrophilic and presumably nontoxic material in 24 h; with Aedes aegypti (L.) larvae this conversion is even less, under 5% in 3 d. There were no significant differences between the two strains in the rate of conversion.

338 Hamilton, E.W. METABOLISM OF ^{36}Cl LABELED ALDRIN AND DIELDRIN IN ALDRIN RESISTANT WESTERN CORN ROOTWORM. Bull. ent. Soc. Am. 11, 3 (1965) 157. Abstr. 48. "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. -2 Dec. 1965".

Aldrin resistant western corn rootworm absorbed aldrin and dieldrin at a lower rate, and metabolized relatively less aldrin to dieldrin, than a susceptible strain. Dieldrin treated resistant rootworms metabolized some dieldrin to aldrin. The aldrin resistance mechanisms in this insect appear to affect the epoxidation chemistry of the insecticides. (Abstr.)

339 Hathway, D.E. THE BIOCHEMISTRY OF DIELDRIN AND TELODRIN. A Review of Recent Investigations Related to the Toxicity of These Compounds in Mammals. Archs envir. Hlth 11, 3 (1965) 380-88.

Review article, drawing liberally on results obtained by the use of radioisotopes (^{14}C to clarify, e.g. the partition of dieldrin and Telodrin between the cellular components and soluble proteins of blood, p.383-5; and to study the two-way transplacental passage of dieldrin and Telodrin, p.385-7).

340 Heath, D.F., Vandekar, M. TOXICITY AND METABOLISM OF DIELDRIN IN RATS. Br.J.ind. Med. 21, 4 (1964) 269-79.

The LD50 (in mg/kg) of pure dieldrin (I) in rats is 50.8-63.5 by oral, 55.9 by intraperitoneal, and 8.4-8.9 by intravenous route. During intravenous infusion, toxicity depended on the rate of infusion, with the tolerance at slow rates comparable to the oral values. Absorption of ^{36}Cl-labelled I from the gastrointestinal tract was much higher when fed as solution in arachis oil than in glycerol-$(MeO)_2$-CH_2; only 8% of the dose was recovered in lymph, showing that I was mostly absorbed via the portal vein. Faecal recovery in 24 h was 20-30, in 4 d 56, and in 28-42 d 70% of the dose after both oral and intravenous dosing, showing that bile was the most important route of elimination; urinary excretion remained below 10-15%. Organ distribution was initially general, but after a few hours it was heavily concentrated in fat. Starvation markedly increased ^{36}Cl excretion. Faeces yielded 4 metabolites distinct from I, but in rats with cannulated bile duct most faecal ^{36}Cl was present as I. Bile contained little unchanged I, with 78% of bilary ^{36}Cl apparently a glucuronide; 10% of the urinary ^{36}Cl was I, and 15% ionic. It was postulated that I was oxidized in the liver to a hydroxy compound, conjugated with glucuronic acid, secreted in bile, and reformed by the action of glucuronidase before excretion. Poisoning was manifested in epileptiform symptoms, with the first convulsion occurring at 40 min after administration over a wide variety of doses. In fatally poisoned animals death took place within 6 h or between 2 and 7 d after dosing; the delayed effect was also known to occur in man and was aggravated by fasting. It was concluded that the toxicity of I was controlled by its fat-solubility, and the delayed effects resulted from release of I during mobilization of adipose tissue where it was stored, rather than from producing a long-lasting lesion in the central nervous system. (Auth.)

341 Korte, F., Arent, H. METABOLISM OF INSECTICIDES. IX. ISOLATION AND IDENTIFICATION OF DIELDRIN METABOLITES FROM URINE OF RABBITS AFTER ORAL ADMINISTRATION OF DIELDRIN-^{14}C. Life Sci. 4, 21 (1965) 2017-26.

Orally administered dieldrin-^{14}C gave six different metabolites isolated in urine of rabbits. The main metabolite was present in amounts of approximately 86%. The chemical structure of the compound was determined. After purification and crystallization it was identified as one of two enantiomers of 1,2,3,4,10,10-hexachloro-6,7-trans-dihydro-1,4-endo-5,8-exodimethano-1,4,4a,5,6,7,8,8a-octahydronaphthalene (6,7-trans-dihydroxydihydroaldrin) (I) with $[\alpha]^{20}_{D} = -13.7$. The acute oral toxicity to mice of the metabolites was about 6-8% that of dieldrin LD50 = 1205 mg/kg. Male rats rats treated intravenously with metabolite excreted 82.2% of the administered activity within 3 d. The extract of faeces gave 84% unchanged I and 16% of a more hydrophilic compound. (CA 64:1966, 5693a)

341-a Ludwig, G., Weis, J., Korte, F. EXCRETION AND DISTRIBUTION OF ALDRIN-^{14}C AND ITS METABOLITES AFTER ORAL ADMINISTRATION FOR A LONG PERIOD OF TIME. Life Sci. 3, 2 (1964) 123-30.

^{14}C-aldrin was fed to male rats in doses of 4.3 µg/d for 3 months. The active material excreted in faeces and urine consisted of aldrin, dieldrin and considerable amounts (up to 75% in the faeces and up to 95% in the urine) of a mixture of hydrophilic metabolism products not yet identified. At the end of the feeding period, the rats had excreted approximately 90% of the total cumulative activity. Practically all (99.5%) of the material administered had been excreted 12 weeks after the last dose. After about 8 weeks approximately the entire activity administered daily was also daily excreted, which means that a saturation level was reached at that stage. Subsequent doses of aldrin did not lead to a cumulation of the toxicant in the organism. (Auth. summary)

341-b Matsumura, F., Hayashi, M. ABSORPTION OF C^{14} DIELDRIN TO THE NERVE COMPONENTS OF THE GERMAN COCKROACH. Bull. ent. Soc. Am. 11, 3 (1965) 157. Abstr. 53. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

It was found that dieldrin forms a complex with several nerve components of chlordane resistant and susceptible German cockroaches. The rate of formation was different in the resistant strains from the susceptible ones. Attempts were made to find the component(s) which yielded the highest interstrain by several biochemical techniques. (Abstr.)

342 Morley, H.V., Chiba, M. DIELDRIN UPTAKE FROM SOIL BY WHEAT PLANTS. Com. J. Pl. Sci. 45, 2 (1965) 209-10.

Separate analyses of the grain and the upper and lower halves of the stems of wheat plants grown in soil containing 2 mg ordinary dieldrin or dieldrin labelled with 10 µCi ^{14}C-dieldrin per 100 g soil in the greenhouse showed them to contain, respectively, 0.14, 0.65 and 0.4 ppm unlabelled dieldrin and 0.06, 0.22-0.67 and 1.05-1.57 ppm labelled dieldrin, thus confirming that the compound is taken up from the soil by wheat plants. (From RAE-A 54:1966, 19)

343 Oonnithan, E.S., Miskus, R. METABOLISM OF C^{14}-DIELDRIN BY DIELDRIN-RESISTANT Culex pipiens quinquefasciatus MOSQUITOES. J. econ. Ent. 57, 4 (1964) 425-6.

Metabolism of ^{14}C-dieldrin by dieldrin-resistant female adult C.p.quinquefasciatus Say has been investigated. Dieldrin is readily absorbed and is metabolized. Using paper chromatographic techniques to resolve dieldrin and metabolite, it has been found that the metabolite is excreted without storage in the body. The metabolite is more polar than dieldrin and was found to have an R_f value close to that of aldrin glycol. (Auth.)

344 Perry, A.S., Pearce, G.W., Buckner, A.J. THE ABSORPTION, DISTRIBUTION, AND FATE OF ALDRIN-^{14}C AND DIELDRIN-^{14}C BY SUSCEPTIBLE AND RESISTANT HOUSEFLIES. J. econ. Ent. 57, 6 (1964) 867-72.

^{14}C-aldrin (specific activity 3.60 mCi/g or 5820 cpm/µg) and ^{14}C-dieldrin (specific activity 3.53 mCi/g or 5750 cpm/µg) were used. Aldrin is epoxidized to dieldrin by both susceptible and dieldrin-resistant houseflies, Musca domestica. Colorimetric analysis, infra-red spectra, and paper chromatography of tissue extracts of treated flies showed no other metabolic product present. Loss of aldrin by volatilization from the surface of application accounts for 40-50% of the applied dose. Dieldrin is neither metabolized nor excreted, but 23-38% is lost by volatilization. In either case, the volatilized material can be recovered in an air-trap apparatus or on strippable film. No difference was found in the distribution of aldrin and dieldrin in the head, thorax, and abdomen of susceptible and resistant houseflies.

345 Shipp, O.E., Brazzel, J.R. DISTRIBUTION OF C^{14}-LABELED DIELDRIN IN DIELDRIN-RESISTANT AND SUSCEPTIBLE BOLL WEEVILS, Anthonomus grandis. J. econ. Ent. 57, 1 (1964) 174-5.

^{14}C-dieldrin (94.4% pure, specific activity 19.46 µCi/mg) was used to determine whether its distribution in A. grandis was related to fat distribution, paper chromatography to test whether a change had occurred in the absorbed insecticide. Dieldrin-resistant (DR) and -susceptible (DS) weevils were analysed. Based on fat content or dry weight of the body parts under consideration (head, thorax, abdomen), dieldrin was found to be distributed in about the same concentrations in DR and DS; in neither case was it related to fat distribution. Dieldrin-resistance may be related to the greater fresh weight of abdomen in DR-weevils.

Thiodan

346 Barnes, W.W. THE ABSORPTION AND METABOLISM OF C^{14}-LABELED ENDOSULFAN IN THE HOUSEFLY. Diss. Abstr. 25, 8 (1965) 4871.

For abstract see 347.

347 Barnes, W.W., Ware, G.W. THE ABSORPTION AND METABOLISM OF C^{14}-LABELED ENDOSULFAN IN THE HOUSE FLY. J. econ. Ent. 58, 2 (1965) 286-91.

The absorption rates of technical endosulfan and each of its four components were studied by paper and gas chromatography. The toxicant was applied topically to cyclodiene-resistant and susceptible female house flies, Musca domestica L., and recovered as external, internal, and faecal extracts in hexane for chromatographic analysis. Endosulphan ether and endosulphan alcohol were absorbed almost completely in less than 2 h, while residues of the high- and low-melting point isomers were detectable in external extracts 24 h after treatment. No difference in the rate of absorption was noted between the two strains. Dosage-mortality determinations indicated the following relative toxicity to 3-d-old female flies of both strains: low-melting point isomer > technical endosulphan > high-melting point isomer > endosulfan sulphate. Endosulfan ether and endosulfan alcohol were relatively non-toxic. The metabolic fate of ^{14}C-labelled endosulfan was studied by the aforementioned means and autoradiography. A previously unreported metabolite found in the internal extracts of both fly strains was identified as endosulfan sulphate, the oxidized form of endosulfan. Endosulfan oxidized in vitro and the metabolite found in internal fly extracts gave identical R_f values and retention times when analysed by paper and gas chromatography. The identity of this metabolite was further confirmed by microcoulometric gas chromatography and by comparison with purified endosulfan sulphate. Judged from visual inspection of gas chromatograms of internal extracts, the high- and low-melting point isomers were metabolized to endosulfan sulphate, while endosulfan ether and endosulfan alcohol were degraded by a different route. The low-melting isomer was absorbing and metabolized to the sulphate more rapidly than the high-melting isomer. Faecal extracts contained traces of unchanged high- and low-melting point isomers but no endosulfan sulphate, indicating its possible role as an intermediate in the metabolic degradation of endosulfan. Paper chromatograms of faecal extracts revealed a water-soluble metabolite and an acetone-soluble metabolite in both strains of flies, but no hexane-soluble derivatives. (Auth.)

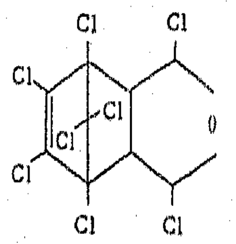
Telodrin

348 Cox, H.C., Bowman, M.C. UPTAKE OF TELODRIN BY FALL ARMYWORM LARVAE EXPOSED TO RESIDUES. J. econ. Ent. 58, 1 (1965) 87-93.

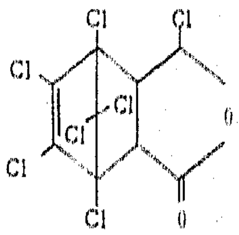
Different instars of the fall armyworm, Laphygma frugiperda (J.E. Smith), were exposed to residues of Telodrin® (1,3,4,5,6,7,8,8-octachloro-1,3,3a,4,7,7a-hexahydro-4,7-methanoisobenzofuran). Insecticide residues were determined by gas-liquid chromatography employing electron affinity detection, radiometrically, and by paper chromatography of ^{14}C-labelled Telodrin. Volatilization of Telodrin from open bioassay jars was considerable within 8 to 24 h. The quantity of toxicant required internally to produce mortality could not be precisely determined for 1st-instar larvae, although the range was 1.19-5.59 ppm. The lethal dosage of Telodrin in the integument and internal organs of third-instar larvae was 5.86 to 6.05 ppm, with about 3.5 ppm in the internal organs. There was no correlation between total lipid content and the lethal dose in individual grown larvae, although there was an indication that mortality of grown larvae was directly related to unsaturated fat content. No detectable metabolism of Telodrin occurred on or in the three larval instars examined under the conditions of these experiments. (Auth.)

349 Korte, F., Stiasni, M. INSECTICIDES IN METABOLISM. VI. CONVERSION OF TELODRIN-^{14}C BY MICROORGANISMS AND MOSQUITO LARVAE. Justus Liebigs Annln Chem. 673 (1964) 146-52. (In German)

Telodrin (I)-^{14}C (labelling with ^{14}C in hexachlorocyclopentene ring) and I-1,3-^{14}C were absorbed by micro-organisms (Aspergillus niger, A. flavus, Penicillium chrysogenum, and P. notatum) and mosquito larvae (Aedes aegypti) and converted into hydrophilic metabolites. After 7-32 d of incubation, I-^{14}C and I-1,3-^{14}C were converted by the micro-organisms into metabolite A, which was converted by hydrolysis with aqueous alcoholic HCl into a weak hydrophilic product. Mosquito larvae converted I-^{14}C and I-1,3-^{14}C into metabolite B, which was different from metabolite A. Metabolite B consisted of at least three components. The hydrolysis product of one of these components was identified (by thin-layer and column chromatography) as II. (CA 61:1964, 4894g)



(I)



(II)

DDT

350 Hoskins, W.M. THE METABOLISM OF DDT IN INSECTS. Wld Rev. Pest Control 3 (1964) 85-96.

Review article. The chronological development in the use of DDT from synthesis, reported in 1874, to large scale manufacture near the end of World War II is traced. The metabolism of DDT in insects and the development of resistance is discussed in detail. Considerable use has been made of radioisotopes, mostly ^{14}C, and numerous references are cited. A table gives results of various studies on the action of DDTase, mostly on Musca domestica. Fundamental differences in the nature of the enzyme in different species have emerged. A number of investigators, using radiometric and chromatographic techniques, have found roaches to form non-SH metabolites more polar than DDE. Typical chromatograms indicating four metabolites from Blattella germanica tissues and three from faeces at 2,3, and 6d after topical treatment are shown (Fig.2). An important metabolite, dicofol, has been identified in several species. So far, no synergist has been found to have a lasting effect on resistance. The question of how to decide whether resistance is due to one or more than one hereditable factor is still a matter of disagreement.

351 Agosin, M., Morello, A., Scaramelli, N. PARTIAL CHARACTERIZATION OF THE IN VIVO METABOLITES OF DDT-^{14}C IN Triatoma infestans. J. econ. Ent. 57, 6 (1964) 974-7.

T. infestans 3rd-instar larvae were topically treated with DDT-^{14}C and Kelthane®-^{14}C (1,1-bis (p-chlorophenyl)-2-2-2-trichloroethanol). After 72 h of DDT-intoxication, 2 DDT-metabolites were detected (metabolites no.2 and no.3), while only one was found from Kelthane after 10 d. DDT metabolite no.3 was characterized by paper chromatography, chemical reactions, and the u.v. spectrum at the microchemical range. The results obtained indicate that metabolite no.3 corresponds to Kelthane. Although no definite identification of DDT-metabolite No.2 and the Kelthane-metabolite was possible, the available evidence suggests that they have the same structure. It is suggested that Kelthane is the precursor of DDT-metabolite no.2, indicating that production of DDT-polar metabolites in T. infestans follows the sequence DDT → Kelthane → metabolite no.2. (Auth.)

352 Atkins, D.L., Williams, R.K. RADIOMETRIC ANALYSIS OF TISSUES FROM CHICKENS FED ^{14}C-[LABELED] DDT. Tex. J. Sci. 16, 4 (1964) 442-45.

Twenty µCi of p,p'-chlorodiphenyl-4-^{14}C-trichloroethane (I) was administered orally in two equal doses at 3 d intervals to sexually mature male and female chickens. No toxicity symptoms were observed. Radiometric measurements of I residues extracted with C_6H_6 from kidney, liver, breast muscle, brain, and reproductive tissues showed accumulation of radioactivity in all tissues. Highest cpm/g of tissue were found in kidney, ovary, and male brain. A very low radioactivity level was absorbed by the testes. This may indicate that avian reproductive failure is a direct rather than indirect reaction of the ovary to I toxicity. (CA 62:1965, 16876h).

353 Backstrom, J., Hansson, E., Ullberg, S. DISTRIBUTION OF DDT-^{14}C AND DIELDRIN-^{14}C IN PREGNANT MICE DETERMINED BY WHOLE-BODY AUTORADIOGRAPHY. Toxic. appl. Pharmac. 7, 1 (1965) 90-6.

The distribution of labelled DDT and dieldrin was compared in pregnant mice, using whole body autoradiography. Both compounds were widely distributed, being found in fat depots, liver, intestines, kidney, mammary glands, urinary and gall bladder, blood, lung, spleen, adrenal, salivary glands, bone marrow, placenta, brain, and spinal cord. Moderate activities of both compounds were found in faetal liver, fat, and intestines. Both compounds also were excreted in the milk, as evidenced by accumulation in the mammary glands and the presence of high concentrations in suckling mice. (CA 62:1965, 13789h)

354 Beard, R.L. COMPETITION BETWEEN DDT-RESISTANT AND SUSCEPTIBLE HOUSE FLIES. J. econ. Ent. 58, 3 (1965) 584.

Radioactive labelling permits the mixing of adult flies of resistant and susceptible strains and identifying their progeny with respect to their parentage. ^{14}C-L-phenylalanine was added to milk powder and fed to newly emerged female flies, when it became metabolized and incorporated into eggs subsequently laid. Larvae, pupae and adults developing from them were radioactive. Radioactive flies of either strain were placed in a cage with non-radioactive flies of the other strain. On the basis of the tests made it can be concluded that different fly strains do indeed differ with respect to their survival in competition, but this phenomenon is not necessarily associated with resistance.

355 Bowery, T.G., Gatterdam, P.E., Guthrie, F.E., Rabb, R.L. FATE OF INHALED C^{14}-TDE IN RABBITS. J. agric. Fd Chem. 13, 4 (1965) 356-9.

New Zealand Red rabbits, selected for their tolerance to main-stream tobacco smoke, were exposed to smoke from cigarettes containing 12 and 48 µg of ^{14}C-TDE* per cigarette in Holland smoking boxes. The animals received smoke from 20 cigarettes per day for periods ranging from 2 weeks - 6 months, after which times they were sacrificed and 20 tissues examined for total and organosoluble radioactivity. The deposition via inhalation appears to follow that of oral ingestion with accumulation of TDE in the fat, followed by slow metabolism and elimination. There was no evidence of accumulation in the inhalation system or other vital organs. Human non-inhaling smokers appear to exhale all TDE components of main-stream smoke, whereas inhaling smokers appear to retain (for subsequent storage and metabolism) about 3% of the TDE contained in a cigarette. (Auth.)

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* 1,1-dichloro-2,2-bis (p-chlorophenyl) ethane

356 Gatterdam, P.E., De, R.K., Guthrie, F.E., Bowery, T.G. THE ABSORPTION, METABOLISM, AND EXCRETION OF C^{14}-LABELLED TDE IN CERTAIN INSECTS. J. econ. Ent. 57, 2 (1964) 258-64.

Among the principal compounds used were 1,1-bis(p-chlorophenyl) 2,2-dichloroethane (TDE, Rhothane®, dichlorodiphenyl dichloroethane); 1,1-bis (p-chlorophenyl) 2,2-dichloroethanol (FW-152); and 4,4' dichlorobenzophenone (DBP). ^{14}C-TDE, labelled at carbon 1 of the ethane moiety was purified; the specific activity was 26 mCi/mM. Information on absorption, excretion, and metabolism of topical applications of ^{14}C-TDE was obtained for two species of lepidopterous larvae and the adult American cockroach, Periplaneta americana (L.). The tobacco hornworm, Protoparce sexta (Johannson), larva and the cockroach formed, internally, significant quantities of FW-152 whereas the red-banded leaf roller, Argyrotaenia velutinana (Walker), larva degraded only minor amounts of absorbed TDE to FW-152 and several other compounds. Certain analogues of TDE were applied to the hornworm and cockroach to determine whether the analogues are stable or transitory intermediates in the overall metabolic scheme. FW-152 appeared to be the major end product in both insects. The compound was apparently formed directly from TDE rather than from an unknown intermediate. There was some evidence that DBP was present in samples of the excreta of the cockroach later on.

357 Bridges, W.R., Kallman, B.J., Andrews, A.K. C^{14} DDT IN A MICROENVIRONMENT AT DENVER. Washington, Fishery Bull. Fish Wildl. Serv. US 199 (1964) 30 and 40.

600 µg of ^{14}C-DDT were placed in 30 l water in each of four aquaria, together with soil and aquatic vegetation. Small bluegills were added to two of them after 28 d, and snails (genus Ampullaria) after 6 weeks. The breakdown of DDT in parts of the system was studied, and also whether DDT would return to the water from high-residue components of the environment after the toxicant had reached near-zero levels in the water. 14 d after DDT had been added, the level in the water was down to 0.42 ppb, with 6.0 ppb in the soil, and 15 600 ppb in the vegetation. At 4 weeks, when the fish were added, the water contained 0.30 ppb. The fish accumulated residues to > 1000 ppb in 1½ weeks, while the amounts in the mud were decreasing and those in the vegetation still increasing. When the snails were added at 6 weeks, the water had 0.19 ppb, the soil 1.1 ppb, the vegetation 23 400 ppb, and the fish 1000 ppb. Two weeks later, the water was reduced to 0.08 ppb, vegetation to 20 700 ppb, and the snails contained 160 ppb. At 15 weeks, all parts of the environment still contained some DDT, but declines were apparent. Residue measurements of DDT and its metabolites are tabulated (Table B-6, p.40).

358 El Sayed, El Basheir, Lord, K.A. DDT TOLERANCE IN DIAZINON-SELECTED AND DDT-SELECTED STRAINS OF HOUSE FLIES. Chem. Ind. 37 (1965) 1958-9.

The metabolism and penetration of DDT in resistant strains of house fly selected by treatment with diazinon (SKA) and with DDT (F58W) were studied by determination of DDT in hexane washings and extracts of the flies by gas-liquid chromatography. It is shown that the proportion of DDT lost from the surface of the F58W strain is less affected by the size of the dose than that lost from the surface of the SKA strain. Much more DDE was found in the F58W than in the SKA or susceptible strains, and the ability of the SKA strain to decompose DDE was demonstrated. Experiments with DDT containing ^{36}Cl gave residues containing ^{36}Cl not detected by the above procedure, indicating an additional unknown mechanism for the decomposition of DDT. (CA 64:1966, 4197a)

359 Hooper, G.H.S. THE MECHANISM OF DDT RESISTANCE IN THE SPOTTED ROOT MAGGOT Euxesta notata. J. econ. Ent. 58, 4 (1965) 608-11.

For absorption studies, a 0.1% wt./vol. solution of ^{14}C-DDT (0.5 µg insecticide) or a 0.01% wt./vol. solution of ^{14}C-dieldrin (0.05 µg insecticide) was applied. The mechanism of DDT-resistance in the spotted root maggot E. notata (Wiedemann), was found to be primarily attributable to decreased cuticular absorption of DDT, with the resistant strain absorbing only half as much as a susceptible strain, rather than to increased detoxication. This finding is of interest since DDT resistance in this fly is due to a single genetic factor. The only metabolite produced from DDT was DDE, and the DDT-susceptible strain showed a high level of dehydrochlorinating activity.

360 Kaddou, I.K., Bull, D.L., Lindquist, D.A. JOINT ACTION OF DDT AND DIELDRIN ON THE BOLL WEEVIL. Bull. ent. Soc. Am. 10, 3 (1964) 163. Abstr.

Combined treatment with DDT and dieldrin were more effective against cyclodiene-resistant and -susceptible boll weevils than either insecticide alone. Radio-labelled materials were used to study possible mechanisms of this joint action. Comparisons of the rates of absorption and metabolism of the insecticides, individually and in combination, will be reported.

361(2) Kalmykov, P.G., Koftyreva, N.V. THE INSECTICIDAL PROPERTIES OF RADIOACTIVE DDT AND THEIR INFLUENCE ON ADULT FLIES AND LARVAE. p.56-59 of "Problemy Parazitologii", Trudy 4-oi Konferentsii Instituta Zoologii, Akad. Nauk Ukr. SSR, Lvov, 1963.

Adult flies and larvae of Protophormia terrae-novae were used. DDT-^{14}C was dissolved to 0.25% in Me$_2$CO and applied to the dorsal surface of the insects. After a certain time, the insecticide was removed from the body surface with Me$_2$CO. The cuticle was washed and the content of radioactive DDT measured. The partition of DDT among the organs was also studied by feeding the flies with milk or meat containing a 0.25% solution of radioactive DDT. The cuticle was permeable to the solution of DDT. One min after DDT was applied it could be detected in chitin, and after 24 h its content in the cuticle was > 2-fold higher. DDT could not diffuse through the cuticle of stage-III larvae. Immediately after application, DDT from the haemolymph was concentrated in the fat body of the fly. After 24 h, DDT was concentrated in the nerve ganglia and in the muscle tissues. After feeding, DDT was concentrated mainly in the nerve ganglia, in the digestive system, and the fat body. In larvae, all body organs were saturated with radioactive DDT within 24 h but only in the final 2 h of this period was DDT within 24 h but only in the final 2 h of this period was DDT concentrated in the nerve ganglia. Thus, the concentration of DDT in the nerve ganglia of the larvae was higher than in the same tissues of the adult flies. (CA 61,1964, 16497f)

362 Kimura, T., Duffy, J.R., Brown, A.W.A. DEHYDROCHLORINATION AND DDT RESISTANCE IN Culex MOSQUITOES. Bull. Wld Hlth Org. 32, 4 (1965) 557-61.

Resistant larvae of C. tarsalis detoxify DDT by dehydrochlorinating it to DDE (Aedes aegypti and the house fly do also), whereas susceptible larvae do not. Resistant larvae of C. fatigans convert all absorbed DDT to the metabolite DDE (according to the scanning of a gas-flow C counter of chromatograms of larvae exposed to radioactive DDT which has ^{14}C on either the C-1 or C-2 of the aliphatic chain). Spectrophotometry and enzyme assays with ring-labelled DDT-^{14}C and paper chromatography in vitro indicate that resistant C. fatigans has 10 times the dehydrochlorinating activity and resistant C. tarsalis 4 times that of their susceptible counterparts. The responsible enzyme in C. fatigans resembles that in A. aegypti in being 1/3 as active on o-chloro derivative of DDT as on DDT and in being inactive against deutero-DDT. It is less active on DDD than on DDT. (CA 63:1965, 13966h)

363 Land, J.D. ABSORPTION AND DISTRIBUTION OF DDT IN THE BOLL WEEVIL AND THE INFLUENCE OF SYNERGISTS ON TOXICITY. Diss. Abstr. 24 (1963/4) 3029.

A total of 58 materials was tested as synergists for DDT against chlorinated hydrocarbon susceptible and resistant boll weevils. The materials consisted of terpene derivatives, commonly available organic solvents, and various commercial products. Mixtures of candidate synergists plus DDT were compared with corresponding mixtures of acetone-DDT, toxaphene-DDT, and Strobane-DDT. Also included in the investigations were the effects of Strobane and two Heyden Newport Chemical Company experimental materials on the absorption of ^{14}C-labelled DDT. The distribution of various chlorinated hydrocarbon, organophosphate, and carbamate insecticides within the body of the boll weevil was studied using radiotracer techniques. Toxaphene, Strobane, and five experimental Heyden Newport chemicals were effective as synergists for DDT against the boll weevil. The experimental Heyden Newport chemicals compared favourably with Strobane as synergists for DDT regardless of whether or not the weevils were of chlorinated hydrocarbon resistant or susceptible strains. Terpene derivatives containing no chlorine were not toxic when applied at 20 µg per weevil but when combined with DDT at 10 µg per weevil the cyclic terpenes (pine oil, pinene, turpentine, camphene, and menthol) were considerably more toxic than the open-chain terpenes (citronella, citronellal, citronellol, and d-limonine). However, pine oil and turpentine were quite toxic when applied at 1 µl, per weevil. Treatment of weevils with 1 µl, of o-dichlorobenzene, tetralin, xylene, cyclohexane, cyclohexanone, cyclohexanol, 2-methyl cyclohexanol, and dipentene resulted in weevil mortalities of 70% or higher when used alone, and no more additive effects were noted when weevils were treated with these solvents plus DDT. Although toluene and isophorone treatments resulted in mortalities below 70% when used alone, these materials were highly effective against the boll weevil when combined with DDT. Armoflo 65 and Armoflo 49 were low in toxicity to the boll weevil but were highly synergistic for DDT. In general the toxicity of DDT-candidate solvent to the boll weevil decreased as the proportion of acetone in the mixture increased. The ratio of adjuvant to toxicant to carrier solvent was quite important in demonstrating synergistic effects. Weevil strain or age had little effect on the toxicity of DDT or toxaphene-DDT mixtures to the boll weevil. Strobane or two of its derivatives had no appreciable effect on the absorption of DDT by the boll weevil. In the distribution studies, considerable amounts of DDT, Sevin, and dieldrin were localized in the fat of the boll weevil; whereas Thio TEPA accumulated in the digestive and reproductive systems. In all treatments with radio-labelled insecticides, the exoskeleton and elytra contained a higher percentage of the applied dose than other tissues and organs assayed. (DA).

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365 Deleted

366 Miller, S., Perry, A.S. SEPARATION AND PURIFICATION OF DDT-DEGRADING ENZYMES FROM THE HUMAN BODY LOUSE. J. agric. Fd Chem. 12, 2 (1964) 167-9.

^{14}C-DDT, 160 µCi/M, was prepared in the laboratory. Purified DDT-degrading fractions were separated from aqueous extracts of human body louse by tertiary amyl alcohol. Purification of the fractions was obtained by calcium phosphate gel adsorption and subsequent elution, acetone fractionation, and chromatography on hydroxylapatite. The crude fractions were heat stable and lost this property upon purification. Based on the various metabolites produced, several enzyme types were considered to occur naturally and not as the result of degradation of a single original native enzyme.

367 Miskus, R.P., Blair, D.P., Casida, J.E. CONVERSION OF DDT TO DDD BY BOVINE RUMEN FLUID, LAKE WATER, AND REDUCED PORPHYRINS. J. agric. Fd Chem. 13, 5 (1965) 481-83.

DDD is often detected as a residue in situations where only DDT has been used, and DDD appears to persist for unusually long periods. Studies with ^{14}C-DDT incubated with bovine rumen fluid, lake water, and aqueous solutions of reduced porphyrins showed partial conversion to ^{14}C-DDD. Conversion by bovine rumen fluid may explain certain DDD residues in milk, and conversion by lake water could account for the apparent extraordinary persistence of DDD in Clear Lake, Calif., because DDT may be available as a continuing precursor for DDD in these situations. The study with reduced porphyrins indicates a possible mechanism for this conversion in biological systems. (Auth.)

368 Morello, A. ROLE OF DDT-HYDROXYLATION IN RESISTANCE. Nature, Lond. 203 (1964) 785-6.

Triatoma infestans 3rd-instar larvae which are fairly tolerant to DDT were used. SKF 525-A (β-diethyl-aminoethyl-diphenylpropyl acetate) or 3-methylcholanthrene were applied topically to the ventral abdominal region of the insect. Iproniazid phosphate in aqueous solution 75µg/3.3µl) was injected intracœlomatically. After 24h, insects were topically intoxicated with 200 µg DDT in acetone per specimen. The effect of iproniazid, SKF 525-A and 3-methylcholanthrene on the in vivo production of DDT-^{14}C internal polar metabolites by nymphs was plotted for five experiments. Iproniazid and SKF 525-A potentiated the effects of DDT. Both were found to substantially decrease the rate of production of polar metabolites, while 3-methylcholanthrene increased their production. Ring-labelled DDT (5000 cpm/µg) was used. A negative correlation between mortality and the rate of production of DDT-polar metabolites was observed.

369 Morello, A. INDUCTION OF DDT-METABOLIZING ENZYMES IN MICROSOMES OF RAT LIVER AFTER ADMINISTRATION OF DDT. Can. J. Biochem. 43, 8 (1965) 1289-93.

DDT is metabolized by rat liver microsomes to a phenolic compound and to a reduced derivative similar to DDD. When rats were injected intra-peritoneally with DDT, the microsomal DDT-metabolizing activity was greatly increased. This effect was blocked by the administration of puromycin. DDT administration also increases the content of liver microsomal protein. The results show that the insecticide probably increases the DDT-metabolizing activity of mammalian liver by inducing enzyme synthesis. Ring-labelled ^{14}C-DDT was used for the enzyme assay.

370 O'Brien, R.D., Matsumura, F. DDT: A NEW HYPOTHESIS OF ITS MODE OF ACTION. Science, N.Y. 146 (1964) 657-58.

It is suggested that DDT and perhaps other chlorinated hydrocarbon insecticides owe their activity to the formation of a charge-transfer complex with a component of the nerve axon, with consequent disturbance of function. Experimental evidence is provided for the formation of two complexes with components of cockroach nerve; the complexes have been partially purified. Their formation is accompanied by an absorption in the 245- to 270-mµ range. Various concentrations of ^{14}C-labelled DDT were used.

371 Peterle, T.J., Meeks, R.L. CYCLING OF CHLORINE-36 LABELED DDT IN A MARSH ECOSYSTEM. p. 67 of "Offsite Ecological Research of the Division of Biology and Medicine Terrestrial and Freshwater". TID-13358 (2nd rev.), Mar. 1965.

The study is aimed at determining the fate of DDT in a marsh ecosystem, with special emphasis on the rate and quantity of DDT uptake by aquatic plants and organisms and to its subsequent translocation within the ecosystem for two growing seasons. On 7 July 1964, 3.9 mCi ^{36}Cl ring-labelled DDT on inert granules were applied by helicopter to an enclosed 4-acre marsh area at the rate of 0.2 lb technical DDT/acre. Plant, animal, soil, and water samples are being collected and analysed radiochemically for DDT 4 h, 8 h, 1 d, 3 d, 1 week, 2 weeks after application and then at 1 month intervals. Following the compilation of residue data based on the radioassay results, the distribution and bio-accumulation of the insecticide are to be described as related to time.

372 Pillai, M.K.K., Brown, A.W.A. PHYSIOLOGICAL AND GENETICAL STUDIES ON RESISTANCE TO DDT SUBSTITUTES IN Aedes aegypti. J. econ. Ent. 58, 2 (1965) 255-66.

Selection with a 1:1 mixture of WARF anti-resistant (N,N-dibutyl-p-chlorobenzenesulfonamide) and DDT, with Prolan® (1,1-bis (p-chlorophenyl)-2-nitropropane) or with malathion induced in larvae of the yellow-fever mosquito, A. aegypti (L.), a DDT resistance characterized by increased DDT-dehydrochlorinase activity. Mixture selection at first reduced the resistance levels of DDT-resistant strains, but ultimately induced high resistance to the DDT and to the mixture; Mixture-resistance derived from genetic influences on chromosome 3 in addition to the regular DDT-resistance gene on chromosome 2. Prolan selection developed the DDT-resistance and in addition a resistance mechanism of reduced Prolan absorption. Malathion selection induced the regular DDT-resistance on chromosome 2 as well as a malathion-resistance connected with multiple genes on chromosomes 2 and 3. The following radioactive chemicals were used: 1) ^{14}C-DDT (ring-labelled on the para-carbons from Tracerlab Inc., activity 3.22 mCi/g, for dehydrochlorination studies; or chain-labelled on the tertiary carbon, from Fordham University, activity 1.75 mCi/g, for absorption studies; and 2) ^{14}C-Prolan, chain-labelled on the tertiary carbon, synthesized at Fordham University, activity 1.30 mCi/g.

373 Plapp, F.W., Jr., Chapman, G.A., Morgan, J.W. DDT RESISTANCE IN *Culex tarsalis* Coquillett: CROSS RESISTANCE TO RELATED COMPOUNDS AND METABOLIC FATE OF A ^{14}C-LABELED DDT ANALOG. *J. econ. Ent.* *58*, 6 (1965) 1064-9.

Larvae of a highly DDT-resistant strain of the mosquito *C. tarsalis* Coquillett were resistant also to dehydrochlorinatible analogues of DDT and to nondehydrochlorinatible analogues such as Prolan® (1.1-bis (*p*-chlorophenyl)-2-nitropropane) and to *o*-chloro DDT (1,1,1-trichloro-2-(4-chlorophenyl)-2-(2,4-dichlorophenyl) ethane. Combinations of DDT and synergists known to block dehydrochlorination failed to overcome resistance. Certain analogues of DDT in which the hydrogen atom on carbon no. 2 was replaced by less easily oxidized groups largely overcame resistance, that is, were about equally toxic to larvae of susceptible and resistant strains. Experiments with a ^{14}C-labelled sample of TDE indicated that both susceptible and resistant larvae detoxified the insecticide by dehydrochlorinative and oxidative routes. The results suggest that resistance to DDT and related compounds in *C. tarsalis* involves a mechanism other than dehydrochlorination. The precise nature of an alternative mechanism was not demonstrated and the nature of the resistance factor must be considered unknown. ^{14}C-TDE, labelled on no. 2 carbon (between the phenyl rings) was used for preparing ^{14}C-TDEE. (Essentially auth.)

374 Schwabe, U. ÜBER DIE VERTEILUNG VON DDT-^{14}C IM ZENTRALNERVENSYSTEM DER KATZE. (The distribution of ^{14}C-labelled DDT in the central nervous system of the cat). *Nauyn-Schmiedebergs Arch. exp. Path. Pharmak.* *250*, 1 (1965) 84-94. (In German, with English summary)

The distribution of labelled DDT in eight different regions of the brain was studied in the cat. After intravenous injection of 25 mg/kg DDT characteristic differences of a dynamic distribution were observed. Within the first 30 min DDT accumulated in brain regions with grey matter. At the same time the white matter contained half as much DDT. This pattern of distribution corresponds to differences in the vascularity of the brain regions. After 4 h the DDT content in the white matter approaches equality to that of the grey matter. Within 24 h and later the DDT level in the whole brain declined. DDT disappeared predominantly from the grey matter, which contained now only half as much DDT as the white matter. At that time the distribution of DDT follows the lipid content of the various brain regions. Convulsion producing doses of DDT (50 mg/kg intravenous) additionally increased the accumulation in the grey matter. This did not occur after suppression of the convulsions by pentobarbital anaesthesia. (Auth. summary)

375 Stenersen, J.H.V. DDT-METABOLISM IN RESISTANT AND SUSCEPTIBLE STABLE-FLIES AND IN BACTERIA. *Nature*, Lond. *207* (1965) 660-1.

Resistant and susceptible stable-flies (*Stomoxys calcitrans* (L.)) were treated with 0.0164 µg ^{14}C-DDT in acetone by topical application. Excrements were collected and extracted. No difference could be observed in the rate of absorption, detoxication or excretion of DDT by resistant and susceptible flies. Both produce only small amounts of DDE. TDE was the only substance detected on the chromatograms of extracts of TDE-treated flies. In the excrements of ^{14}C-DDT-treated flies, DDT, DDE, TDE, and MI were found. MI was water-soluble and could be hydrolysed by acid to give a substance less soluble in water. When growing anaerobically or in oxygen deficiency, the facultative anaerobes *Serratia marcescens*, *Escherichia coli*, and an unidentified strain converted DDT almost completely (~90%) and DDE slightly (5%). In aerated cultures neither the facultative anaerobes nor the obligate aerobes converted any DDT to TDE or other products. As there is no difference in the rate of absorption, metabolism or excretion by resistant and susceptible flies, the resistance mechanism must be of an unusual kind, and not a detoxication mechanism despite the high degree of resistance present.

376 Upshall, D.G., Goodwin, T.W. SOME BIOCHEMICAL INVESTIGATIONS INTO THE SUSCEPTIBILITY OF BARLEY VARIETIES TO DDT. *J. Sci. Fd Agric.* *15*, 12 (1964) 846-55.

The internal DDT deposits in the leaves of a barley strain (Rika) which is susceptible to DDT and of one (Proctor) which is resistant, were found to be the same. DDT specifically accumulated to the same extent in both strains. Neither DDT (2.56×10^{-5} M) nor DDE (2.75×10^{-5} M) inhibited the Hill reaction in either strain. When DDT at approximately 30 ppm was included in a water culture solution, no adverse effect on the root system of either strain was noted; only very slight uptake of DDT into the plant was noted. The susceptible strain when germinated in the presence of DDT is not adversely affected until the 10th d, i.e. when all food reserves are used up. No significant metabolism of DDT by either strain could be observed even when ^{14}C-DDT was used. Examination of 19 DDT analogues revealed three structural requirements for toxicity. (^{14}C-DDE was prepared from chromatographically pure ^{14}C-*pp*'-DDT by exposing DDT in alkaline ethanol to u.v. light.) It is concluded that DDT exerts its toxic effect in Rika by gaining access to a functional lipoprotein in the chloroplast by being able to penetrate the membrane; in Proctor it is adsorbed on the chloroplast but presumably cannot penetrate the chloroplast membrane. (Essentially auth.)

377 Zubairi, M.Y., Cutkomp. L.K. THE PICK-UP OF ^{14}C-DDT AT DIFFERENT TEMPERATURES. *Entomologia exp. appl.* *7*, 2 (1964) 139-43.

An account is given of experiments carried out with larvae of *Aedes aegypti* (L.) to test the hypothesis that the cuticle of insects sorbs more of a toxicant at a lower temperature and thus may permit greater availability at the site of action than at a higher temperature. The larvae picked up progressively greater amounts of ^{14}C-DDT with increasing temperature in the range of 10-30°C, but mortality decreased. The pick-up relations were the same when heads, thoraces and abdomens were compared separately. The thoraces contained greater concentrations than heads or abdomens at 30 and 20°C. At 10°C, heads contained more than thoraces and abdomens, but the amount was still less than that picked up at 20 and 30°C. The results show a positive coefficient of pick-up DDT but a negative temperature coefficient for mortality, provided that the concentration of DDT is not too high. The latter relation agrees with considerable earlier research. The explanation for the negative temperature effect of DDT is still not understood, but the evidence indicates that it is not positively related to pick-up by whole larvae or portions of them. (From RAE-B 53:1965, 151)

Chlordan

378 Poonawalla, N.H., Korte, F. METABOLISM OF INSECTICIDES, VIII (1): EXCRETION, DISTRIBUTION AND METABOLISM OF α-CHLORDAN-^{14}C. *Life Sci.* *3* (1964) 1497-1500.

After intravenous administration male rats excreted 30% of the injected 27 µg of α-chlordan-^{14}C, most of which was found to have been metabolized. The alimentary tract contained a high percentage of metabolites, whereas unchanged α-chlordan was found in subcutaneous fat only. (Auth. summary)

See also:

435 Penetration of insecticides through rat skin. (O'Brien, R.D., Dannelley, C.E., 1965)

4. Organophosphorus Insecticides

General

379 Kaloyanova-Simeonova, F.P. TOXICOLOGY OF ORGANIC PHOSPHORUS COMPOUNDS. *Toksikol. Novykh Prom. Khim. Veshchestv* 7 (1965) 122-38. (In Russian)

Rats, guinea pigs, and rabbits received daily, for up to 2.5 months, subcutaneous injections of 1/4 the LD50 of parathion (*I*), chlorothion (*II*), or malathion (*III*). The administration of *I* and *III* caused rabbits to die within a month, guinea pigs within 10-25 d, and rats within 17-90 d, while on *II* rabbits survived over 2 months, guinea pigs over 50 d, and rats survived longer than the rabbits. Determination of blood cholinesterase activity (*IV*) revealed it to be practically identically affected by the three pesticides under investigation; after approximately ten injections, the *IV* activity drops in all the animals to ~20% of its original value, and continues low thereafter.

The effect of II and III on protein synthesis was studied in two groups of rats administered a single 4/5 LD50 amount of these pesticides, followed 3 h later by intraperitoneal injections of methionine-^{35}S or glycine-^{14}C. After 24 h the rats were sacrificed and the labelled methionine and glycine content in the protein of liver, brain, and blood serum globulins was determined. A definite lowering of the incorporation of ^{35}S was observed in rats having received II, and a trend in the same direction in those treated with III, while the incorporation of ^{14}C was invariably higher, as compared with the controls (CA 63:1965, 7603g)

Phosphorus Aliphatic Derivatives

Dipterex

380 Hassan, A., Zayed, S.M.A.D. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. III. FATE OF THE METHYL GROUPS OF DIPTEREX IN VIVO. Can.J. Biochem. 43, 8 (1965) 1271-5.

Direct evidence for the hydrolysis of O-methyl ester linkage(s) of Dipterex in the rat has been obtained using Dipterex in which the two methyl groups are ^{14}C-labelled. (A patent has been applied for this method of preparing radioactive Dipterex). Following a single intraperitoneal injection of radio-Dipterex, about 60% of the ^{14}C activity was recovered, after 24 h, in the expired air and in the urine. $^{14}CO_2$ and ^{14}C-formate constituted about 50% of the recovered radioactivity. The contribution of P–OCH_3 cleavage to the detoxification of the insecticide has been discussed. A scheme for the fate of the methyl groups has been suggested.

381 Hassan, A., Zayed, S.M.A.D., Hashish, S. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. VI. MECHANISM OF DETOXIFICATION OF DIPTEREX IN THE RAT. Biochem. Pharmac. 14, 11 (1965) 1692-94.

To study the mechanism of detoxification of Dipterex in rats, a sublethal dose (100 mg/kg body weight) of the labelled drug was injected intraperitoneally. Within 48 h 75-85% of the administered dose was excreted in the urine; monomethyl phosphate accounting for 20-30%, dimethyl phosphate accounting for 60-70%, and an unidentified metabolite accounting for ~10% of the total metabolites. After acid hydrolysis, only monomethyl phosphates and dimethyl phosphates were detected by paper chromatography, probably indicating that the unidentified metabolite gave mono-Me phosphate or di-Me phosphate upon hydrolysis. It was concluded that the activities of esterase and phosphatase proceeded independently; yet products formed by hydrolysis through phosphatases were further acted upon by esterases so that metabolites with an intact phosphonate bond never appeared in the urine. (CA 64:1966, 5690f)

382 Hassan, A., Zayed, S.M.A.D., Abdel-Hamid, F.M. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. II. METABOLISM OF O,O-DIMETHYL-2,2,2-TRICHLORO-1-HYDROXYETHYL PHOSPHONATE (DIPTEREX) IN MAMMALIAN NERVOUS TISSUE AND KINETICS INVOLVED IN ITS REACTION WITH ACETYLCHOLINE ESTERASE. Can. J. Biochem. 43, 8 (1965) 1263-9.

The metabolism of ^{32}P-labelled Dipterex in rat brain homogenates has been investigated. The presence of four metabolites, three acidic and one nonacidic, has been demonstrated. Monodemethylated Dipterex and monomethylphosphate contributed to 37% and 7% of the total metabolite output respectively. The third acidic metabolite (16%) is believed to be 2,2,2-trichloro-1-hydroxyethyl phosphonic acid. The non-acidic compound has not yet been identified. The reaction of Dipterex with acetylcholine esterase has been found to be of bimolecular nature. (Auth.)

383 Hassan, A., Zayed, S.M.A.D., Abdel-Hamid, F.M. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. V. MECHANISM OF DETOXIFICATION OF DIPTEREX IN *Prodenia litura*. Biochem. Pharmac. 14, 11 (1965) 1677-84.

The metabolism of Dipterex in the cotton leaf worm *P. litura* has been investigated in vivo, using ^{32}P- and ^{14}C-labelled insecticide. From the topically applied dose (2 mg/g insect), 40-45% was excreted as ^{32}P-labelled hydrolytic products during 20 h. The first major ^{32}P-labelled metabolite is produced by hydrolysis of both O-Me ester linkages, and eliminated as glucuronide. This metabolite constitutes 65-75% of the total metabolite output. The second metabolite contributes 25-30%, and was dimethyl phosphate. Monomethyl phosphate (~5%) was also identified as a metabolic product. Radioactive CO_2 in the expired air accounted partly for the fate of the Me groups of the insecticide. The possible metabolic pathways have been discussed. (CA 64:1966, 4196d)

II/674 Kühnert, M., Dedek, W., Schwarz, H. DETERMINATION OF THE EFFECT OF THE PHOSPHONATE TRICHLORPHON, IN THE COMMERCIAL PREPARATION BUBULIN, ON THE METABOLISM AND EXCRETORY MECHANISM OF COWS GIVEN INTRAVENOUS AND INTRAMUSCULAR INJECTIONS, WITH THE AID OF RADIOACTIVE PHOSPHORUS. Arch. exp. Vet Med. 17 (1963) 403-17. (In German)*

Bubulin (I), a commercial preparation containing 500 g O,O-dimethyl 1-hydroxy-2,2,2-trichloroethylphosphonate (trichlorphon), 5 g pyridine-2-aldoxime methiodide (PAM), and 1.5 g atropine sulphate in 1 l of higher alcohols, was labelled with ^{32}P and injected into cows. Only traces of radioactivity were found in the faeces. Blood determinations showed that > 95% of I was metabolized to non-toxic products within 1 h after intravenous injection, but I was detected in the blood as long as 6 h after intramuscular injection. I was excreted in the milk for as long as 10 h after intramuscular injection, whereas injected DDVP could not be detected. Mainly non-toxic metabolites of I were detected in the urine. Injection of I lowered the Ca and Hg content and erythrocyte and lymphocyte counts of the blood serum and increased the granulocyte count. Intravenous and intramuscular injection of 20 and 25 mg I/kg respectively, evoked no histopathological changes in the liver. (CA 63:1965, 15471c)

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* See II/674 (without abstract).

384 Mostafa, I.Y., Hassan, A., Zayed, S.M.A.D. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES: TRANSLOCATION AND METABOLISM OF ^{32}P-LABELLED DIPTEREX IN COTTON PLANT. Naturwissenschaften 20b, 1 (1965) 67-70. (In English)

^{32}P-labelled Dipterex was prepared from the hemiacetal obtained by inter-reaction of equivalent amounts of chloral and methanol. This method is under patentation. The uptake of ^{32}P-Dipterex by the cotton plant, *Gossypium barbadense*, was studied following topical application on the leaf, as well as via the root. The insecticide did not penetrate into the leaf cells when applied topically but was readily taken up by the root when immersed in a solution of radioactive insecticide. The rate of respiration was found to increase significantly in plants treated with sublethal concentrations of Dipterex. The metabolic fate of Dipterex within the plant tissues was also investigated. Dimethylphosphate, monomethylphosphate and inorganic phosphate have been identified as degradation products of the insecticide.

385 Vashkov, V.I., Khudadov, G.D., Zakolodkina, V.I. THE RATE OF PENETRATION AND ACCUMULATION OF CHLOROPHOS-^{32}P IN VARIOUS ORGANS AND TISSUES OF HOUSE FLIES. Zh. Mikrobiol. Épidem. Immunobiol. 42, 8 (1965) 3-6. (In Russian)

Experiments with chlorophos-^{32}P were carried out on 7-d domestic female flies (laboratory strain) sensitive to insecticides. Alcoholic chlorophos solution (0.6-0.9 g/fly) was applied to the mediodorsal region with a micropipette. The insects were kept in glass jars covered with gauze on which a piece of cotton moistened with sugar sirup was placed for purposes of nutrition. The flies were examined 30 min, 1, 2, 3, 4, and 6 h after insecticide application. The greatest amounts of chlorophos or its metabolites were detected in the haemolymph, digestive system, and heat ganglion 30 min after the application; 1-6 h after the application, the amount of chlorophos or its metabolites manifested a considerable reduction in the digestive system and the Malpighian vessels. The amount of chlorophos or its metabolites in the thoracic ganglion increased at first and then lessened. Traces of chlorophos or its metabolites were detected 1-2 h after the application, but none was found later. Small amounts of chlorophos and its metabolites were detected in the wing muscles 30 min after application of the insecticide. The amount increased 1 h after the application and then decreased. (CA 63:1965, 17069a)

386 Zayed, S.M.A.D., Hassan, A. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. I. DISTRIBUTION AND METABOLISM OF DIPTEREX IN ADULT LARVA OF THE COTTON LEAF WORM (*Prodenia litura* F.). Can. J. Biochem. 43, 8 (1965) 1257-62.

The distribution of ^{32}P-labelled Dipterex among different organs of the adult larva of the cotton leaf worm showed that the major radioactivity was translocated in haemolymph and gut. Dipterex was readily metabolized in vitro to give monodemethylated Dipterex which contributed to 91% of the acidic metabolites. Monomethylphosphate (about 9%) could also be identified as a metabolic product. The low toxicity of Dipterex to *Prodenia* larvae is probably due to preferential methyl ester cleavage. (Auth.)

387 Zayed, S.M.A.D., Hassan, A., Hussein, T.M. STUDIES ON ORGANOPHOSPHORUS INSECTICIDES II. DISTRIBUTION AND METABOLISM OF ^{32}P-*O*-*O*-DIMETHYL-2,2,2-TRICHLORO-1-METHOXYETHYL PHOSPHONATE IN THE ADULT LARVA OF "*Prodenia litura* F." *Z. Naturf.* *20b*, 6(1965)587-91. (In English)

The distribution of ^{32}P-labelled *O*,*O*-dimetheyl-2,2,2-trichloro-1-methoxyethyl phosphonate (*I*) among different organs of adult larva of *P. litura* F., showed that considerable radioactivity was translocated in haemolymph and gut. Significant accumulation of the ^{32}P-activity in the fat with time has been observed. The in vivo metabolic rate of *I* in *Prodenia* larvae was relatively small (12-16% of the applied dose during 20 h). The major metabolite (75-85%) is produced by splitting of both *O*-methyl ester linkages, and excreted as glucuronide. Monomethyl- (5-10%) and dimethyl phosphates (10-15%) were also identified as metabolic products. *I* was originally obtained by methylation of Dipterex, and was found to be more stable and possess a lower anticholinesterase activity. Its toxicity to *P. litura* was comparable to Dipterex.

388 Zayed, S.M.A.D., Hassan, A., Fakhr, I.M.I. I. PREPARATION OF SOME DIPTEREX ANALOGUES AND STABILITY OF *O*,*O*-DIMETHYL-2,2,2-TRICHLORO-1-METHOXYETHYL PHOSPHONATE. *Z. Naturf.* *20b*, 8 (1965) 786-90. (In English)

Dipterex (*O*,*O*-dimethyl-2,2,2-trichloro-1-hydroxy-ethyl phosphonate) was synthesized with ^{32}P, and labelled *O*,*O*-dimethyl-2,2,2-trichloro-1-methyoxyethyl phosphonate (I_b) prepared from it. Dipterex and its homologues were obtained in good yields by a single vessel reaction. The stability of I_b towards temperature and pH variation was studied using labelled compounds; I_b proved much more stable than the parent substance, Dipterex. The anticholinesterase activity of Dipterex was found to be more than 300 times higher than that of the methyl ether I_b, thus proving a correlation between the presence of the free hydroxyl group in Dipterex and its anticholinesterase activity.

389 Zayed, S.M.A.D., Mostafa, I.Y., Hassan, A. METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES. VII. TRANSFORMATION OF ^{32}P-LABELED DIPTEREX THROUGH MICROORGANISMS. *Arch. Mikrobiol.* *51*, 2 (1965) 118-21.

During the metabolism of Dipterex-^{32}P (1-hydroxy-2,2,2-trichloroethylphosphonic acid (*I*) di-Me ester) by *Aspergillus niger*, *Penicillium notatum*, and *Fusarium* spp., at least two hydrolytic metabolites have been detected. One of them is identified as *O*-methyl-2,2,2-trichloro-1-hydroxylethyl-phosphonic acid and comprises 30-44% of total metabolite output. The other is believed to be *I*. (CA 63:1965,12254b)

Dichlorvos

390 Millar, K.R., Aitken, W.M. RESIDUE IN MEAT FOLLOWING EXPOSURE TO ^{32}P-LABELED DICHLORVOS VAPOR IN AN ENCLOSED SPACE. *N.Z. Jl agric. Res.* *8*, 2 (1965) 350-62.

Concentrations of dichlorvos (*I*) were determined in meat samples following exposure to the insecticide maintained at a concentration of approximately 0.5 γ/l of air for 30 min. The *I* did not penetrate deeply into tissues and it was readily decomposed in minced meat and steak. Frying and boiling steak containing *I* completely destroyed the insecticide, only hydrolytic products being found. The effect of *I* on adult blowflies (*Lucilia sericata*) was also investigated, both during actual spraying and in the period following treatment. Two weeks after spraying, a complete kill of released flies was obtained after 3-4 h of exposure. In general, meat treated with *I* under conditions effective in practice would be safe for human consumption. (CA 63:1965,3536h)

Azodrin

391 Bull, D.L., Lindquist, D.A. METABOLISM OF AZODRIN IN INSECTS, RATS, AND PLANTS. *Bull. ent. Soc. Am.* *11*, 3 (1965) 56. Abstr. 42. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

The oxidative and hydrolytic metabolism of radiolabelled Azodrin was compared in five species of insects, white rats, and cotton plants. Oxidative conversion of Azodrin to the *N*-methylol derivative was an important reaction in animals but not in plants. *N*-demethylation appeared to be a minor reaction (Abstr.)

392 Ridgway, R.L. SYSTEMIC ACTIVITY OF AZODRIN* IN THE COTTON PLANT. *Bull. ent. Soc. Am.* *11*, 3 (1965) 177. Abstr. 459. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

Bioassay and radioassay techniques were used to study the systemic activity of Azodrin in the cotton plant. Little or no Azodrin translocated following foliar application. However, relatively large amounts were found in nectar following stem application. Azodrin was not particularly effective when applied as a seed or soil treatment. (Abstr.)

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* SD-9129 (3-hydroxy-*N*-methyl crotonamide dimethyl phosphate)

Bidrin

393 Bull, D.L., Lindquist, D.A. METABOLISM OF 3-HYDROXY-*N*,*N*-DIMETHYLCROTONAMIDE DIMETHYL PHOSPHATE BY COTTON PLANTS, INSECTS, AND RATS. *J. agric. Fd Chem.* *12* (1964) 310-7.

The nature and rate of the in vivo metabolism of the experimental systemic insecticide Bidrin were compared in cotton plants, two species of cotton insects (boll weevil and boll worm), and white rats, through the use of radiometric techniques. Bidrin-^{32}P or Bidrin-^{14}C was used. Oxidative demethylation of the toxicant to its equally toxic *N*-methyl derivative occurred in all biological materials, but all toxic products decomposed rapidly. Of nine P-containing metabolites detected, six hydrolytic and two oxidative products were identified tentatively. A major metabolite that occurred in treated plants was not completely identified, but was shown to contain almost all the original Bidrin molecules.

394 Bull, D.L., Lindquist, D.A. THE EFFECTS OF CHRONIC DOSES OF AN ORGANOPHOSPHORUS INHIBITOR ON CHOLINESTERASE ACTIVITY IN BOLL WEEVILS. *Experientia* *21*, 5 (1965) 262-3.

Adults of *Anthonomus grandis* Boheman were fed with sustained doses of Bidrin (3-hydroxy-*N*,*N*-dimethyl-*cis*-crotonamide dimethyl phosphate). Sublethal and lethal doses were used. Some physiological mechanism stopped cumulative inhibition and allowed recovery of cholinesterase activity in spite of continued treatment. ^{14}C-Bidrin was used.

395 Corey, R.A. LABORATORY TESTS WITH BIDRIN INSECTICIDE. *J. econ. Ent.* *58*, 1 (1965) 112-4.

Bidrin® insecticide (3-(dimethoxyphosphinyloxy)-*N*,*N*-dimethyl-*cis*-crotonamide), or SD 3562, was found highly toxic to nine insect or mite species in laboratory tests. It is a systematic toxicant which can enter platns through roots, seeds, or leaves. Bidrin is water soluble and leaches readily through soil, and is quickly decomposed in moist soil. The stability of Bidrin in a sandy loam soil of varying moisture content was measured by means of liquid-liquid partition or paper chromatography of a ^{14}C-labelled product. That it is relatively stable in plants is shown by its residual toxicity to two-spotted spider mites, *Tetranychus telarius* (L.), and Mexican bean beetle (*Epilachna varivestis* Mulsant) larvae in the laboratory and to grape leafhoppers, *Erythroneura comes* (Say), and walnut aphids, *Chromaphis juglandicola* (Kaltenbach), in field tests.

396 Hall, W. E., Sun, Y. -P. MECHANISM OF DETOXICATION AND SYNERGISM OF BIDRIN INSECTICIDE IN HOUSE FLIES AND SOIL. J. econ. Ent. 58, 5 (1965) 845-9.

With ^{14}C-labelled Bidrin ® insecticide (3-hydroxy-N,N-dimethyl-cis-croton-amide dimethyl phosphate), some studies have been made on its detoxication by house flies, Musca domestica L., and its stability in soil. House flies were treated topically with tagged Bidrin with and without the synergist sesamex. Two hours after treatment, the following effects were observed with synergist: increase in knockdown from 10-15% to nearly 100%; no significant effect on absorption; considerable reduction in the excretion of radioactive compounds; lower degree of metabolism of Bidrin; the absence of one route of metabolism. One of the metabolites found in a significant quantity in the absence of synergist, but very little when synergist was present, was identified as the highly toxic compound 3-hydroxy-N-methylcrotonamide dimethyl phosphate (SD 9129). Bidrin was quickly detoxified in soil. However, considerable stabilization of Bidrin in soil was observed when treated with 500 ppm of sesamex, chloropicrin, Nemagon ® soil fumigant (1,2-dibromo-3-chloropropane), chloromycetin, acti-dione, Shell 345 Soil Fungicide ® (diacetoxy propene) or O,O,O-trimethyl phosphorothioate (SD 4741). Detoxication of Bidrin was also greatly reduced in sterilized or "air dry" soil. (Auth.)

397 Lindquist, D. A., Bull, D. L., Ridgway, R. L. SYSTEMIC ACITIVITY OF BIDRIN IN THE COTTON PLANT. J. econ. Ent. 58, 2 (1965) 200-3.

Radioassay with ^{32}P-labelled Bidrin® (3-hydroxy-N,N-dimethyl-cis-croton-amide dimethyl phosphate) and bioassay with cotton aphids, Aphis gossypii Glover, were used to study the systemic activity of the insecticide in cotton plants. Direct application of Bidrin to the stems of cotton plants was a more efficient method of applying the toxicant than soil injection, seed treatment, or foliar sprays. (Auth.)

398 Menzer, R. E., Casida, J. E. NATURE OF TOXIC METABOLITES FORMED IN MAMMALS, INSECTS, AND PLANTS FROM 3-(DIMETHOXYPHOSPHINYLOXY)-N,N-DIMETHYL-CIS-CROTONAMIDE AND ITS N-METHYL ANALOG. J. agric. Fd Chem. 13, 2 (1965) 102-12.

Bidrin, 3-(dimethoxyphosphinyloxy)-N,N-dimethyl-cis-crotonamide, is metabolized to yield trace amounts of 3-(dimethoxyphosphinyloxy)-N-methyl-N-hydroxymethyl-cis-croton-amide and larger amounts of 3-(dimethoxyphosphinyloxy)-N-methyl-cis-crotonamide (SD 9129). SD 9129 is further metabolized to yield 3-(dimethoxyphosphinyloxy)-N-hydroxy-methyl-cis-crotonamide and 3-(dimethoxyphosphinyloxy)-cis-crotonamide. The toxicity to both insects and mammals increased upon successive N-demethylation. Balance studies on the fate of the ^{32}P and ^{14}C from Bidrin-^{32}P, Bidrin-N-methyl-^{14}C, SD 9129-^{32}P, and SD 9129-N-methyl-^{14}C are considered. Studies on milk residues, urinalysis, and metabolism in house flies (Musca domestica L.) and bean plants, and toxicity to adult American cockroach (Periplaneta americana (L.)) are reported. An unusual pattern of synergism of the toxicity of the Bidrin metabolites in house flies by sesamex [2-(2-ethoxyethoxy)ethyl-3,4-(methylenedioxy)phenyl acetal of acetaldehyde] was noted.

Demeton

399 Dedek, W. ZUR KENNTNIS DER HYDROSE- UND ISOMERISIERUNGSREAKTIONEN EINIGER SYSTOXHOMOLOGEN. (Hydrolysis and isomerization reactions of some Systox compounds). Atompraxis 10, 4 (1964) 164-7. (In German)

The rate constants of the hydrolysis and isomerization reactions of four insecticidal thiophosphoric acid esters of the Systox type were determined by means of ^{32}P-labelled substances. The course of the reaction is in line with existing hypotheses. The following radioactive substances were synthesized: ^{32}P-thiophosphoryl bromide, $PSBr_3$; ^{32}P-dialkylthiophosphoric acid bromide, $(RO)_2{}^{32}P(S)Br$; and ^{32}P-(O,O-dialkyl-O(β-alkylmercaptoethyl)-thionophosphate, $(RO_2)^{32}P(S)OCH_2CH_2SR$.

Phorate

400 Jaccquinot, L., STUDY BY MEANS OF ^{35}S ON THE RESIDUES OF AN INSECTICIDE ON MILLET. Agron. trop., Nogent 19, 12 (1964) 1081-8. (In French)

Millet seed with 2.75% of $(EtO)_2P(S)SCH_2SEt$, tagged with ^{35}S, was sowed. Extracts of leaves were analysed by paper chromatography with Me_2CO-EtOH-H_2O (30:30:40). R_f value of the major radioactive component was 0.77, 0.90, and 0.95 for all 4-cm plants germinated within 15, between 15 and 20, and between 20 and 25 d from date of sowing, respectively. The R_f of the control was 0.50. (CA 63:1965, 1145g)

Di-Syston

401 Bull, D.L. METABOLISM OF DI-SYSTON BY INSECTS, ISOLATED COTTON LEAVES, AND RATS. J. econ. Ent. 58, 2 (1965) 249-54.

Di-Syston® (O,O-diethyl S[2-(ethylthio)ethyl]phosphorodithioate) was absorbed, metabolized, and excreted rapidly by 5th-instar bollworms, Heliothis zea (Boddie), and adult boll weevils, Anthonomus grandis Boheman. Insects excreted the toxic oxidative derivatives as well as the hydrolytic products of Di-Syston metabolism, but rats slowly excreted only hydrolytic products. As many as four oxidative and nine hydrolytic metabolites of Di-Syston were detected in the biological systems used. The oxidative products included the sulphoxide and sulphone derivatives of Di-Syston of the oxygen analogue of Di-Syston. In animals and plants, the initial oxidative reaction with the Di-Syston molecule occurred at the mercapto sulphur atom. In plants, Di-Syston was converted almost quantitatively to its sulphoxide derivative during the first few minutes after treatment. The chief hydrolytic products of Di-Syston metabolism were diethyl phosphate and O,O-diethyl phosphorothioate. In addition, small concentrations of ethyl phosphate, phosphoric acid, and five unidentified products were detected in certain samples. O,O-diethyl phosphorodithioate was not formed in insects or plants but trace amounts of the metabolite were detected in the urine of treated rats. Similar products were formed in the different biological systems but the rates of metabolism varied considerably. Two batches of pure (> 98%) ^{32}P-labelled Di-Syston with initial specific activities of 2.5 mCi/g^2 and 10.6 mCi/g^2, respectively, were used.

402 Bull, D.L. METABOLSIM OF DI-SYSTON IN INSECTS AND RATS. Bull. ent. Soc. Am. 10, 3 (1964) 165. Abstr. 96.

Both oxidative and hydrolytic conversion of ^{32}P-labelled Di-Syston occurred in 5th-instar bollworms, Helothis zea (Boddie), and male white rats. The nature and relative concentrations of different metabolites were determined by standard radiometric procedures.

403 Ridgway, R. L., Lindquist, D. A., Bull, D. L. EFFECT OF METHOD OF APPLICATION ON UPTAKE OF DI-SYSTON BY THE COTTON PLANT. J. econ. Ent. 58, 2 (1965) 349-52.

^{32}P-labelled Di-Syston® (O,O-diethyl S-[2-(ethylthio)ethyl] phosphorodithioate) was applied to the soil with and without irrigation and at a variety of locations in relation to the cotton plant. Results indicated that irrigation, deep placement, and sidedressing on both sides instead of on one side of the drill row increased uptake. Radioassay of different parts of the cotton plant indicated that after applications were made to soil greater quantities of radioactivity accumulated in the leaves than elsewhere. After application to the stem, Di-Syston did not translocate to other parts of the plant to the extent reported for some other systemic insecticides (Auth.)

Malathion

404 Giles, R. H., Jr. THE ECOLOGY OF A SMALL FORESTED WATERSHED TREATED WITH THE INSECTICIDE MALATHION-S^{35}. Diss. Abstr. 25, 2 (1964) 731.

The faunal ecology of two 20-acre forested watersheds near Dover, Ohio, was studied for 1 year before aerially spraying one watershed with 2 lb/acre of malathion-^{35}S. Effects were studied for one year after treatment. Many different sampling devices and methods were used to measure the effects of the insecticide on populations of soil microfauna, arthropods, mollusks, reptiles, amphibians, birds, and mammals. Barium sulphate precipitates were prepared of samples of animals, plants, soil, and water. The radioactivity of the ^{35}S in these samples was measured. Amounts of malathion, its metabolites, or components within the samples were determined. Malathion was followed from the airplane, within the air, over the canopy, through the three-layered deciduous forest, within soil, and within animals and plants. The insecticide had limited effects on mammals and birds; no effect on reptiles, amphibians, and mollusks; some effect on microarthropods; and variable effects on fish and on hundreds of arthropod families. The insecticide apparently reduced mammalian population size; caused the cessation of bird singing for 2 d post-spray; had no effect on reptile, amphibian, and mollusk populations; had a short-term effect on soil microarthropod populations; had no effect on soil bacterial and fungal populations; and had no apparent effect on some insect populations, though greatly reducing others. There was no evidence of population resurgence following disruption of predator-prey balances. (DA)

405 Koivistoinen, P., Vanhanen, L., Koskinen, E.H. DISAPPEARANCE OF MALATHION RESIDUES FROM GOOSEBERRIES AT DIFFERENT RESIDUE LEVELS. J. agric. Fd Chem. 13, 4 (1965) 344-6.

Post-harvest applications of ^{32}P-labelled malathion at different initial deposit levels were made on gooseberries which were then subsequently stored at 22-25°C. The berries were analysed after 3 and 7 d of storage, and the distribution patterns of malathion-^{32}P into chloroform-soluble, water-soluble, and inextractable fractions as well as the loss from the berries were determined. In the 7-d pattern, which was, except the lowest residue level, essentially the same as the 3rd pattern, the proportion of the ^{32}P-activity in the chloroform fraction was 31% at the initial deposit level of 2.2 ppm, 44% at the 130 ppm level, 85% at the 330 ppm level, and 95% at the 1802 ppm level. The amounts of malathion-^{32}P found in the water fractions varied from 59% at the lowest to 3% at the highest residue level. The actual figures in malathion equivalents for the four application levels were 1.1, 51, 38, and 38 ppm, indicating the presence of a malathion-degrading enzyme system in gooseberries with a limited capacity. The amounts of radioactivity not extractable from the berry solids to either the chloroform or water fractions varied from 10% at the lowest to 2% at the highest level. Of the initial loads of radioactivity, 14-23% or 0.3-324 ppm in malathion equivalents was not recovered. This study indicates that the disappearance behaviour of residues of malathion may depend on the amount of the initial deposit. (Auth.)

406 Koivistoinen, P., Karinpää, A., Könönen, M., Vanhanen, L. EXTRACTION OF MALATHION RESIDUES FROM FRUITS. J. agric. Fd Chem. 13, 4 (1965) 347-9.

Stripping unmacerated crops with benzene as an extraction method for malathion post-harvest residues on fruits was compared with three other methods: blending the crop in water with subsequent tumbling with benzene, blending in ethanol with subsequent tumbling with benzene, and drastic blending in chloroform followed by additional extractions with a methanol-acetone mixture. One extraction method was used both on small crop samples (~20 g) containing ^{32}P-labelled malathion residues and on larger samples (250 g) having inactive residues. To study the efficiency of this method, ^{32}P-labelled malathion was applied to gooseberries after harvest by dipping in a malathion emulsion. The fruit was then stored at ~20°C. The chloroform-soluble, water-soluble, and inextractable radioactivity levels were assayed just after application and twice during the first week of storage (see Tables 3 and 4). - In all cases stripping the unmacerated crops gave the highest values of initial deposits and in most cases also the highest residue recoveries during the first few days after malathion application; later, slightly higher recoveries were obtained from blended macerated materials.

407(2) Giles, R.H., Jr., Peterle, T.J. NEW TRACER TECHNIQUES FOR EVALUATING THE EFFECTS OF AN INSECTICIDE (MALATHION) ON THE ECOLOGY OF A FOREST FAUNA. Washington. Fishery Bull. Fish Wildl. Serv. US 167 (1961/62) 100.

See II/677; TID-13650, Ohio State Univ. Research Foundation, Columbus, 31 Aug. 1961. 22p.

408 Mansingh, A. THE EFFECT OF MALATHION ON THE CATABOLISM OF LABELLED GLUCOSE IN Blattella germanica (L.). Indian J. Ent. 26, 4 (1964) 423-33.

A malathion-susceptible (S) and a resistant (R) strain of B. germanica were used in a study of the metabolic interrelationship between carbohydrates, proteins, amino acids, and lipids of malathion-intoxicated roaches. Glucose-U-^{14}C was catabolized mainly into $^{14}CO_2$, carbohydrates, organic acids and sugar phosphates, free amino acids and protein. Trehalose and glycogen were found to be the major storage forms of sugars. The existence of an efficient mechanism of carbohydrate-amino acid interconversion is indicated. Free glutamate, aspartate, glutamin-asparagine, serine, glycine, alanine and proline incorporated ^{14}C from the administered glucose-U-^{14}C. Malathion-intoxication of S-roaches increased the $^{14}CO_2$-output by ~84%, lowering the concentrations of glucose, trehalose, glycogen, and some of the free amino acids, whilst also slightly lowering ^{14}C-incorporation into body proteins. No evidence of any effective inhibition of glycolysis of Krebs' TCA cycle was found. Poisoned R-roaches catabolized the administered glucose similarly to the S-roaches, except for slightly increased sugar utilization. The presence of a protective mechanism which indirectly prevents the depletion of carbohydrates by malathion action is indicated. The effect of malathion on the carbohydrate metabolism in insects appears to be secondary to some primary lesion which involves endergonic reactions.

409 Matsumura, F., Hogendijk, C.J. THE ENZYMATIC DEGRADATION OF MALATHION IN ORGANOPHOSPHATE RESISTANT AND SUSCEPTIBLE STRAINS OF Musca domestica. Ent. expl appl. 7 (1964) 179-193.

^{32}P-malathion was synthesized from ^{32}P-phosphoric acid and purified by column chromatography. ^{32}P-malaoxon was prepared by peracetic acid oxidation of ^{32}P malathion and separated from it by an alumina absorption column. ^{14}C-malathion, labelled in the two and three positions of the succinyl moiety was also used. The metabolic fate of labelled malathion in both strains of flies was studied in vivo and in vitro. The main interstrain difference was the superior ability of the two malathion-resistant strains to degrade malathion to its monocarboxylic acid derivative. Attempts were made to characterize the carboxyesterases responsible for this difference with respect to heat stability, pH dependency and organophosphate inhibition, and to estimate their importance in causing resistance by means of cross-resistance and synergism experiments. The relation to, and possible identity of the carboxyesterases with, the malaoxon degrading enzymes previously found in the malathion-resistant strains is discussed.

410 Matsumura, F., Voss, G. MECHANISM OF MALATHION AND PARATHION RESISTANCE IN THE TWO-SPOTTED SPIDER MITE, Tetranychus urticae. J. econ Ent. 57, 6 (1964) 911-17.

^{14}C-malathion (^{14}C-succinyl labelled) aand ^{3}H-parathion (^{3}H-ethyl labelled) were used. Comparative studies on the breakdown activities in organophosphate-resistant and -susceptible spider mite, (T. urticae Koch) strains, against radioactive malathion and parathion and non-radioactive malaoxon and para-oxon revealed that the resistant Blauvelt strain had a superior ability to detoxify malathion, parathion, and malaoxon as compared with the susceptible Niagara strain. In the case of malathion breakdown, the highest interstrain difference was found in the amount of carboxyesterase products, but a substantial difference in the phosphatase activity was also observed. These results were in accordance with the experiments in vivo with radioactive malathion and parathion. A second OP-resistant spider mite strain, characterized by another protection mechanism, also showed a high rate of malathion and parathion breakdown. The total uptake of malathion by the Blauvelt strain did not significantly differ from that by the Niagara strain. The rate of ChE inhibition in vivo in Niagara mites was much higher than in Blauvelt mites. Furthermore, homogenates of the Blauvelt strain were found to hydrolyse ß-naphthyl benzoate at a higher rate than Niagara homogenates. The unique features of the malathion-resistance in the Blauvelt strain were compared with data already published on malathion-resistance in mosquitoes and house flies (Musca domestica L.).

411 Matsumura, F., Voss, G. PROPERTIES OF PARTIALLY PURIFIED MALATHION CARBOXYESTERASE OF THE TWO-SPOTTED SPIDER MITE. J. Insect Physiol. 11, 2 (1965) 147-60.

Niagara normal and Blauvelt resistant strains of Tetranychus urticae Koch were used. The toxic phosphorus compounds employed were ^{14}C-malathion (2,3-succinyl carbon labelled), ^{3}H-parathion (ethyl hydrogen labelled), non-radioactive malaoxon, and di-isopropyl phosphorofluoridate (DFP). The malathion carboxyesterase found in a multiple organophosphate-resistant strain of the spider mite was purified about 80-fold and characterized. It was shown to have hydrolytic activities against malathion (carboxyesteratic as well as phosphoroesteratic), malaoxon, parathion (phosphoroesteratic), and a number of naphthyl and nitrophenyl esters. By comparing it with its counterpart in susceptible mites and using differential inhibition techniques, it was concluded that (1) malathion carboxyesterase and an aliesterase which hydrolysed β-naphthyl benzoate were inseparable, and that (2) malathion- and parathion-phosphatase belonged to a different enzyme group from that of the carboxyesterase of malathion. The additional carboxyesterase of the resistant strain had 20 times as high an affinity to the substrate as that of the susceptible strain, if the Km measures affinity. This enzyme differs from that of susceptible mites in being very sensitive to dilution and dialysis at low concentrations and by being eluted at a different salt concentration from a DEAE-cellulose column.

412 Peterle, T.J., Giles, R.H., Jr. NEW TRACER TECHNIQUES FOR EVALUATING THE EFFECTS OF AN INSECTICIDE ON THE ECOLOGY OF A FOREST FAUNA. Final Report, December 1, 1960 - November 30, 1963. TID-20355, Ohio State Univ. Research Foundation, Columbus. Jan. 1964, 444p.

The faunal ecology of two deciduous-forested, 20-acre water-sheds near Dover, Ohio, was studied intensively for 1 year. The second year, one of the watersheds was aerially sprayed with 2 lb/acre of malathion labelled with ^{35}S. Effects of the insecticide were studied by sampling all faunal segments from the microbiota of the soil to raccoons. The insecticide and its metabolites were followed from the airplane through the air, the forest vegetation, and in soil and water. Results indicate that malathion is an effective insecticide that, although harmful to some forms, is of short residue and permits rapid recovery of decimated or altered populations. (NSA 18:1964, 17362)

Dimethoate

413 Lindquist, D.A., Hacskaylo, J., Davich, T.B. EFFECT OF LIGHT AND HUMIDITY ON THE ABSORPTION AND TRANSLOCATION OF DIMETHOATE IN THE COTTON PLANT. J. econ. Ent. 58, 3 (1965) 415-8.

^{32}P-dimethoate was used. In studies of absorption and translocation of dimethoate by cotton plants, as affected by different light and humidity conditions, similar amounts of dimethoate were absorbed by the roots of plants whether maintained in the light or the dark. Cotyledons also accumulated similar amounts of dimethoate during an 8-h exposure. Leaves on the same cotton plant, but under different conditions of light and humidity accumulated different amounts of dimethoate. Both humidity and darkness resulted in greatly reduced dimethoate accumulation in the leaves.

414 Pietro-Tonelli, P. de PENETRATION AND TRANSLOCATION OF ROGOR APPLIED TO PLANTS. Adv. Pest Control Res. 6 (1965) 31-84.

After dealing with the physico-chemical and toxicological properties of Rogor, the author concentrates on the systemic effects of the insecticide. In the subsequent sections on the systemic effect of Rogor intensive use had been made of ^{32}P. The subject is considered in terms of the systemic effect after foliar application (penetration into the leaf, migration from one half of the leaf blade to the other, migration through the veins, translocation from leaf to leaf, outward translocation from leaves to fruits, translocation from leaves to fruits, and translocation from leaves to roots); the systemic effect after fruit application (penetration into the fruit, migration from one half of the fruit to the other, and translocation from fruits to leaves); the systemic effect after twig application (penetration and migration in, and translocation from the twigs); the systemic effect after stem application (translocation from stem to leaves, and from the trunk to aerial and ipogeal organs of the plant); and the systemic effect after complete and partial spray application to aerial part of the plant.

415 Sanderson, D.M., Edson, E.F. TOXICOLOGICAL PROPERTIES OF THE ORGANOPHOSPHORUS INSECTICIDE DIMETHOATE. Br. J. ind. Med. 21, 1 (1964) 52-64.

$(MeO)_2P(S)SCH\ CONHMe$ (dimethoate) was studied as the pure compound (recrystallized from absolute ether, odourless) (I); as the laboratory grade material (all physical constants as I, but possessing thiol odour) (II); as technical grade (containing about 7% $(MeO)_2P(S)SMe$) (III); as liquid formulation (32-40% III in $MeO(CH_2)_2OH$ or in cyclohexanone) (IV); or as a wettable powder (20% III in china clay) (V). Single oral LD50 of I in rats, hamsters, guinea pigs, and rabbits was 500-680, in mice 60, and in birds 15-50 mg/kg. I changes into II on standing, with substantial increase in toxicity for most species. III, IV, and V had toxicities as high or higher than II; IV showed lower LD50 in $MeO(CH_2)_2OH$ than in cyclohexanone due to exchange of alcoholic radicals during storage, the isolated reaction product having LD50 of 1 mg/kg. Intraperitoneal, intravenous, and subcutaneous single LD50's were similar to the oral values. Signs of poisoning are typical for a cholinesterase (VI) inhibitor, and are delayed 0.5-2 h after dosing, dependent on the purity of the material. Death followed after 3-30 h, or recovery took place in 2-4 d. Survivors showed no permanent ill-effects. In rats dosed with 190-300 mg II/kg, erythrocyte and plasma-VI fell to 15% of pre-exposure level in 3 and 20 h, respectively, but both values recovered to 85-100% in 14d; brain-VI fell to 37% in 7 d and recovered to 60% only. Dermal LD50 on 24-h contact in rats was 700-1150, the lowest VI-inhibiting dose was 30-50 mg/kg. In humans, ^{32}P-labelled IV applied to skin was largely unabsorbed after 5.5 h. Upon daily intraperitoneal administration of II to rats, the highest non-lethal dose was 40, the highest non-toxic dose 3, and the highest non-VI-inhibiting dose 0.7 mg/kg/d. There were no toxic effects in humans ingesting 0.04 mg II/kg daily, or 0.25 mg/kg as a single dose; during prolonged dietary administration of II or IV to rats animals receiving 0.4-0.8 mg/kg/d (5-10 ppm) were indistinguishable from controls by any criterion including VI activity. The concentration causing 50% inhibition of rat brain VI is 8.5×10^{-3} M for I, and 1×10^{-3} M for II. Toxicity of I is due to in vivo oxidation to its P:O analogue and three other metabolites (separated by $CHCl_3$ extraction). Plant metabolites are identical to those formed in the liver; sprayed vegetation presents no extra hazard. Work of other authors is reviewed. (CA 61:1964, 4895b)

416 Uchida, T., Dauterman, W.C., O'Brien, R.D. THE METABOLISM OF DIMETHOATE BY VERTEBRATE TISSUES. J. agric. Fd Chem. 12, 1 (1964) 48-52.

The ability of vertebrate tissues to degrade dimethoate in vitro was investigated. ^{32}P-labelled dimethoate was synthesized and purified essentially as described in J. agric. Fd Chem. 7:1959, 188; the steps by which ^{32}P-labelled dimethoate acid was synthesized biochemically are described. Dimethoate was degraded rapidly in rat liver but very little in other (rat) tissues. The degrading activity of the livers of other species was, in descending order: rabbit, sheep, dog, rat, cattle, hen, guinea pig, mouse, and pig. The activities were related to the toxicity of dimethoate. Dimethoate acid was the only product from sheep liver; O,O-dimethyl phosphorodithioate was the only product from guinea pig liver. Rat and mouse livers gave both products. In sheep liver, degradation was by a microsomal amidase, some of its properties being described.

417 Uchida, T., Rahmati, H.S., O'Brien, R.D. THE PENETRATION AND METABOLISM OF H^3-DIMETHOATE IN INSECTS. J. econ. Ent. 58, 5 (1965) 831-5.

The toxicity, penetration, and metabolism of dimethoate were studied in Musca domestica L., the American cockroach, Periplaneta americana (L.), the Colorado potato beetle Leptinotarsa decemlineata (Say), the large milkweed bug Oncopeltus fasciatus (Dallas), and the house cricket Acheta domesticus (L.). Aqueous ^{3}H-dimethoate (1 µl) was injected into the abdomen. There were marked variations in toxicity, penetration, and metabolism, including a 5-fold variation in net production of oxygen analogue and a 100-fold difference in cholinesterase sensitivity. Differences in penetration were seen during the initial 30 min, but thereafter the speed was almost the same for all species. The highly sensitive house fly showed particularly rapid penetration, extensive production of oxygen analogue, and sensitive cholinesterase. However, variations in these factors could not explain all the variations in toxicity to the five species.

418 Wang, W.-Y., Wu, C.-L. THE TOXICITY OF ROGOR A NEW INSECTICIDE. Iglena 13, 3 (1964) 201-6.

The toxicity of Rogor (I) was investigated in mice after oral administration. The LD0, LD5, LD50 and LD100 values were 60, 80, 126, and 240 mg/kg, respectively. The minimum dose of I affecting the activity of blood cholinesterase was 10 mg/kg. Injections of 5 mg atropine/kg or 45 mg PAM/kg 0.5-1 h prior to the administration of I, increased the LD50 2-fold. I reduced the rate of ^{131}I uptake and ^{131}I release by the thyroid in mice. (CA 62:1965, 3344b)

Phosphorus Phenyl (Carbocyclic) Derivatives

419 Metcalf, R.L., Reynolds, H.T., Fukuto, T.R., Collins, C. FACTORS INFLUENCING THE SYSTEMIC INSECTICIDAL ACTION OF SUBSTITUTED PHENYL DIMETHYL PHOSPHATES. J. econ. Ent. 57, 4 (1964) 531-6.

^{32}P-radiotracers of 2,4,5-trichlorophenyl dimethyl phosphate (A), 4-methylthiophenyl dimethyl phosphate (B), and 4-nitrophenyl dimethyl phosphate (C) were used to study the systemic insecticidal activity of these compounds in cotton plants following application to the stem or as a 5% granule to the soil about the roots. Although all three compounds are effective contact insecticides, neither A nor C was appreciably active as a systemic insecticide and only traces of the intact insecticides could be found in the leaves up to 32 d after treatment. However, B is an active systemic insecticide and this observation was in agreement with the findings of the radiotracer investigations which showed relatively large amounts of B or its toxic oxidation products in leaves and squares. It was concluded that B was more soluble in the lipoid cuticle of the cotton plant and that its oxidation in the plant environment to the more toxic sulphoxide and sulphone derivatives provided the necessary "delay factor" so that it was translocated in lethal amounts. (Auth.)

Methyl Parathion

420 Lybeck, H., Leppaluoto, J., Aito, H. THE EFFECT OF AN ORGANOPHOSPHORUS CHOLINESTERASE INHIBITOR, METHYL PARATHION, UPON THE ACCUMULATION OF IODIDE BY THE THYROID GLAND. Ann. Acad. Sci. Fennicae, Ser. A V (Suomal. Tiedeakat. Toim., Sarja A V) 106, 17 (1964) 8p. (In English)

Methylparathion (150 γ) (I) or 1 mg propylparathion (II) was given to female rats, followed by intraperitoneal injection of 20 µCi ^{131}I. The percent uptake was less than in controls, with max blocking effects of I and II seen after 8 h, and decreasing thereafter. The effect of I was greater than II in applied dosages. (CA 61:1964, 15282h)

Parathion

421 Cavalcaselle, B., Bellis, E. de, Liani, A. PRELIMINARY INVESTIGATIONS ON THE ABSORPTION OF PARATHION-^{32}P BY POPLAR STEMS. Ente Naz. Cell. Carta. Cent. Sper. Agr. Forest. P. 7 (1964) 89-97.

422 Iyatomi, K., Saito, T. METABOLISM OF PARATHION IN RESISTANT AND SUSCEPTIBLE RICE STEM BORER. p. 500-1 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul. 1964". Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

The metabolic fate of topically applied ^{32}P-parathion was studied in larvae. Chloroform extracts of homogenized larvae contained parathion, paraoxon, and their still active metabolites, and degraded substances in the water extract. Detoxication of ^{32}P-parathion and paraoxon by the tissues of the resistant and susceptible borer in vitro was examined. Results showed that blood has the most important role in detoxication of parathion and paraoxon in the resistant strains. Although differences have been found between the resistant and susceptible strains of borer with regard to the zymograms of esterases separated and revealed by means of the thin layer agar gel electrophoresis, there is no conclusive evidence that such differences may account for resistance to parathion. Parathion-resistant borers showed no cross-resistance to methyl parathion and EPN. There was no significant difference in the rate of destruction of ^{32}P-methyl parathion between resistant and susceptible strains. Thus, parathion resistance does not exhibit a group resistance pattern as does chlorinated hydrocarbon resistance, and the mechanism of resistance seems to be related to slight structural changes in the organophosphorus insecticides. Resistance to parathion is relatively unstable, and on removal of selection pressure, resistant borers decrease their detoxication ability and become susceptible again in six generations.

423 Matsumura, F., Hogendijk, C.J. THE ENZYMATIC DEGRADATION OF PARATHION IN ORGANOPHOSPHATE-SUSCEPTIBLE AND -RESISTANT HOUSEFLIES. J. agric. Fd Chem. 12, 5 (1964) 447-53.

The metabolic fate of parathion and diazinon, in one organophosphate-susceptible and two resistant strains, was studied by chromatography and radioisotope techniques. ^{32}P-parathion and diazinon were synthesized from ^{32}P-phosphoric acid. Paraoxon was obtained from ^{32}P-parathion by means of peracetic acid oxidation at 35°C for 12 h, or synthesized from $^{32}POCl_3$ obtained from $H_3{}^{32}PO_4$. The main interstrain difference resulted from the superior ability of the resistant strains to degrade parathion to diethyl phosphorothionate. The enzyme involved in the degradation process in the strains S and Ka was purified about 30 times by acetone powder formation, DEAE-fractionation, and ethanol precipitation. The partially purified enzyme preparations obtained from all three strains hydrolysed parathion and diazinon to diethyl phosphorothionate, but their activity in hydrolysing paraoxon was relatively low. The importance of these interstrain differences in relation to organophosphate resistance is discussed.

424 Mengle, D.C., Lewallen, L.L. METABOLISM OF P^{32} LABELED PARATHION IN SUSCEPTIBLE AND PHOSPHATE-RESISTANT STRAINS OF THE MOSQUITO Aedes nigromaculis (Ludlow). Bull. ent. Soc. Am. 10, 3 (1964) 165. Abstr.

Radioactive parathion, synthesized in the laboratory, was applied to A. nigromaculis (Ludlow) larvae collected from various locations in the San Joaquin Valley. Bioassay indicated as high as 1000-fold resistance between populations. Results indicate greater insecticide hydrolysis in resistant larvae, resistance more closely correlated with breakdown of paraoxon than parathion.

425 Hilton, B.D., O'Brien, R.D. SYNTHESIS OF H^3-ETHYL PARATHION. J. econ. Ent. 58, 5 (1965) 1025-6.

The synthesis of ^{3}H-parathion (2.5 mM) is described, the ^{3}H-alcohol being introduced in the final step. The synthesis of p-nitrophenyl phosphorodichloridothionate (PDT) is included since it is not available commercially. The isotopic yield of parathion was 45%, of 97% purity. The method is equally suitable for ^{14}C-ethyl parathion. The authors point out that the principle of ^{3}H-alkylating in the terminal synthetic step should be applicable to many other organophosphates, and have so far succeeded in preparing the appropriate intermediate for ronnel and its P-(O) analogue.

426 Nakatsugawa, T., Dahm, P.A. PARATHION METABOLISM BY LIVER MICROSOMES. Bull. ent. Soc. Am. 11, 3 (1965) 157. Abstr. 57. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

^{35}S-parathion activation by liver microsomes showed binding of ^{35}S onto microsomes nearly equivalent to the paraoxon formed. A more abundant, ^{35}S-metabolite was water soluble and extractable from acidic media with chloroform or ethyl acetate. The microsomal system split parathion at the arylphosphate bond. All reactions required $NADPH_2$ and oxygen. (Abstr.)

427 Potter, J.L., O'Brien, R.D. PARATHION ACTIVATION BY LIVERS OF AQUATIC AND TERRESTRIAL VERTEBRATES. Science, N.Y. 144 (1964) 55-57.

^{3}H-parathion was synthesized by reacting ^{3}H-ethanol with P_2S_5, chlorinating the mixture with SO_2Cl_2, and reacting the resultant diethyl phosphorochloridothionate with sodium p-nitrophenate (with a yield of 2.5%, and a specific activity of 7.58 mCi/mM). Liver slices from seven terrestrial and six aquatic animals were studied for their ability to activate parathion, and to convert it to paraoxon, a potent anticholinesterase. Although there are similarities between the liver systems which activate parathion and which degrade drugs such as aminopyrine and phenacetin, liver slices of aquatic vertebrates can activate parathion but cannot degrade such drugs.

428 Saito, T. TOXICOLOGICAL ASPECTS OF INSECTICIDE RESISTANCE. Jap. J. Med. Sci. Biol. 17, 1 (1964) 44-6.

Larvae of Chilo suppressalis were treated topically with 0.6 γ parathion-^{32}P (II). After 1 d at 25°C the larvae were homogenized with H_2O and extracted with $CHCl_3$ and 2 N HCO_2H in 80% EtOH. Analysis of the extracts showed that more II had been detoxified by the resistant strains. The metabolites of II in the susceptible strain were about equal parts of diethyl parathion (III), diethyl thiophosphoric acid, diethyl phosphoric acid, H_3PO_4, and thiophosphoric acid. The resistant strains showed more II in the metabolites. The mechanism of resistance was suggested as involving a dealkylation of paraoxon. (CA 61:1964, 8835b)

429 Zschintzsch, J., O'Brien, R.D., Smith, E.H. THE RELATION BETWEEN UPTAKE AND TOXICITY OF ORGANOPHOSPHATES FOR EGGS OF THE LARGE MILKWEED BUG. J. econ. Ent. 58, 4 (1965) 614-21.

Eggs of the large milkweed bug, Oncopeltus fasciatus (Dallas), are totally insensitive to parathion vapour, but freshly emerged larvae are sensitive. Work with ^3H-parathion showed that large quantities are taken up by the eggs, but very little reaches the embryo. However, on emergence from poisoned eggs, larvae rapidly take up parathion from the egg and die soon thereafter. Ten other organophosphates and two carbamates are, like parathion, without ovicidal action on this species; but dichlorvos and trichlorfon are lethal to the late stages of developing eggs. Studies with ^{14}C-dichlorvos showed that extremely large quantities are taken up by the eggs, and a large fraction of it reaches the embryo. It is concluded that the non-toxicity of parathion is a penetration phenomenon, involving either a barrier or very poor partitioning from external lipid into the egg interior; but the ineffectiveness of dichlorvos to early stages may be due to their intrinsic insensitivity. (Auth.)

Paraoxon

430 Fredriksson, T. THE PERCUTANEOUS ABSORPTION OF PARATHION AND PARAOXON. VI. IN VIVO DECOMPOSITION OF PARAOXON DURING THE EPIDERMAL PASSAGE. J. invest. Derm. 42 (1964) 37-40.

In the cat the rate of percutaneous absorption of paraoxon following topical application of 50 µl ^{32}P-labelled material measured 6×10^{-9} mole/min/cm^2. The radioactivity of the blood after 3 h corresponded to 0.05 γ/ml paraoxon. Inhibition of plasma cholinesterase activity was the same as with non-labelled paraoxon, indicating that the radiation of a high-energy β-ray emitter does not injure the absorption barrier. Almost 90% of the topically applied paraoxon was detoxified by enzymes in the skin before it was absorbed by the capillaries. (CA 60:1964, 13772d)

Colep

430-a Marco, G.J., Jaworski, E.G. METABOLISM OF O-PHENYL O'-(4-NITROPHENYL) METHYLPHOSPHONOTHIONATE (COLEP) IN PLANTS AND ANIMALS. J. agric. Fd Chem. 12, 4 (1964) 305-10.

O-phenyl-^{14}C-O'-(4-nitrophenyl) methylphosphonothionate (Colep-^{14}C) was synthesized with uniformly labelled phenol to a specific radioactivity of 0.97 mCi/mM. A solution of the compound in ethanol (5.2 mg/ml) was applied by microsyringe to the individual leaves. The time course metabolism of Colep was followed for 28 d in apple and cotton seedlings. Thin layer chromatography in several solvent systems of the benzene, chloroform, and water extracts of the apple and cotton leaves showed a variety of radioactive compounds other than Colep. Because acid hydrolysis converts most of the radioactivity in all extracts to phenol, the variety of radioactive compounds separated by chromatography represent phenolic-containing materials. Within 24 h, most of the radioactivity from an oral dose of Colep is excreted in the urine of rats. No activity is found in the respired CO_2 or fat tissue. Little activity is found in the intestines, liver, kidneys, or faeces. Thin layer chromatographic and ion exchange analyses of the urine indicate the presence of a mixture of polar phenolic conjugates.

Sumithion

431 Miyamoto, J. THE MODE OF ACTION OF PRGANOPHOSPHORUS COMPOUNDS. III. ACTIVATION AND DEGRADATION OF SUMITHION AND METHYL PARATHION IN MAMMALS IN VIVO. Agric. biol. Chem., Tokyo 28, 7 (1964) 411-21.

The fate of sumithion (I) and methyl parathion (II) in guinea pigs and rats was studied. I and II, labelled with ^{32}P, were given to the animals intravenously. The tissue was homogenized, deproteinized, and extracted with $CHCl_3$. Radioactive materials in both water and $CHCl_3$ were determined by paper chromatography. Both I, II and their oxons were detected in all the tissues a few minutes after the administration. Non-toxic $CHCl_3$-insoluble demethyl compounds were richly present in liver and kidney. (CA 62:1965, 1027c)

432 Reynolds, H.T., Fukuto, T.R., Metcalf, R.L. SYSTEMIC ACTIVITY OF p-METHYLTHIOPHENYL ALKOXY ALKYLPHOSPHONOTHIOATES IN COTTON PLANTS. Bull. ent. Soc. Am. 10, 3 (1964) 164. Abstr.

Systemic phosphonate and phosphate insecticides with p-methylthiophenyl moiety were screened against cotton pests following topical and soil treatments. The most effective, O-p-methylthiophenyl O-methylmethylphosphonothioate, and several oxidative derivatives were then field-evaluated. Radiotracer studies of absorption, translocation and metabolism were made under controlled laboratory conditions.

Ronnel

433 Millar, K.R. RESIDUES IN TISSUES OF SHEEP FOLLOWING ORAL DOSING AND TIP SPRAYING WITH ^{32}P-LABELLED RONNEL. N.Z. Jl agric. Res. 8, 2 (1965) 302-12.

Following oral dosing of sheep at a rate of 100 mg/kg live weight Ronnel (O,O-dimethyl O-(2,4,5-trichlorophenyl) phosphorothioate) (I) appeared rapidly in the blood of sheep. The highest concentrations found were attained 4 h after treatment. After 21 d, 70% of the administered dose had been detected in the urine, and 7% in the faeces, largely as O-methyl, O-(2,4,5-trichlorophenyl) phosphorothioate, and dimethylphosphorothioic and -phosphoric acids. No appreciable amounts of I were found stored in the fat. Residues in subcutaneous fat taken from sheep sprayed with 600 ml of 0.2 and 0.4% solutions of I were negligible, the maximum concentration found being 0.35 γ/g 1 week after treatment. No I could be detected in the fat 3 weeks after spraying and presumably the animals could then be used for food. The metabolism of I in sheep appears to follow very closely that of the cow and rat. Results indicated satisfactory agreement between radiochemical and cholinesterase inhibition methods of estimating unchanged I. (CA 63:1965, 3536f)

Famphur

434 O'Brien, R.D., Kimmel, E.C., Sferra, P.R. TOXICITY AND METABOLISM OF FAMPHUR IN INSECTS AND MICE. J. agric. Fd Chem. 13, 4 (1965) 366-9.

Famphur [p-(dimethylsulphamoyl)phenyl dimethyl phosphorothionate] was essentially equitoxic by injection into mice, female and male cockroaches, and milkweed bugs, but was degraded at greatly differing rates in these organisms, decreasing in the above order. The level of the oxygen analogue (famoxon) was examined in the whole organisms and roughly paralleled the famphur level. In the insects only, N-demethylation occurred. The slow degradation rate in the milkweed bug appeared to be compensated by a relative insensitivity of its cholinesterase to famoxon. The variations in degradation rate among mice and two sexes of cockroach were relatively small (1.9-fold) and were deemed not to require postulation of important differences in innate sensitivity of insects and mammals. Radioactive famphur, ring-labelled with ^3H to give a specific activity of 78.5 mCi/mM, its unlabelled and labelled P(O) analogue, famoxon, its unlabelled mono-N-demethylated derivative and ring-labelled N-dimethyl-p-sulphamoylphenol were used.

435 O'Brien, R.D., Dannelley, C.E. PENETRATION OF INSECTICIDES THROUGH RAT SKIN. J. agric. Fd Chem. 13, 3 (1965) 245-47.

^3H-carbaryl (1-naphthyl N-methylcarbamate) (ring-labelled, with a specific activity of 3.7 mCi/M), ^3H-famphur (dimethyl p-N-dimethylsulfamoylphenyl phosphorothionate) (ring-labelled, with a specific activity of 78.4 mCi/mM), ^{14}C-DDT (labelled in the alkane carbons, at 4.93 mCi/mM), ^{14}C-ethane-labelled malathion (at 3.9 mCi/mM, and ^{14}C-ring-labelled dieldrin (at 20.5 mCi/mM) were used. The penetration through rat skin of DDT, famphur, carbaryl, malathion, and dieldrin was examined using radioactive compounds. The penetration rates varied markedly, increasing in the above order, and the rate was not related to the olive oil-water partition coefficient. Compounds also varied in the proportion which could be recovered from skin by acetone washing. The vehicle in which the compounds were applied also influenced penetration rate, which increased in the order oil, benzene, acetone.

Cidial

436 Bazzi, B., Fabrini, R. METODO DI DETERMINAZIONE DEI RESIDUI DELL'ESTERE ETILICO DELL'ACIDO O, O-DIMETILDITIOFOSFORIFENILACETICO (CIDIAL®) NELL'OLIO DI OLIVA IN BASE AL DOSAGGIO SPETTROFOTOMETRICO DEL FOSFORO. SEPARAZIONE DAL ROGOR E DAL SUO ANALOGO OSSIGENATO. (Method for determining residues of the ethyl ester of O, O-dimethyldiothiophosphoryl phenyl acetic acid in olive oil, based on spectrophotometric determination of the phosphorus. Separation of Rogor and its oxygen analogue). "Estratto da "Atti" del III Convegno sulla Qualità, Perugia, 25-27 May 1964". (In Italian)

^{32}P-labelled Rogor was used.

437 Bazzi, B., Fabrini, R., Canale, G. METHODE DE DETERMINATION DES RESIDUS DE L'INSECTICIDE CIDIAL DANS LES OLIVES. "Extrait du Volume de Conférences et Communications du VIème Congrès de l'Association Internationale d'Expertise Chimique, Athène, 7-12 Sep. 1964". (In French)

On décrit une méthode de microdétermination chimique du Cidial employé contre le Coccus oleae dans les olives. Le procédé est basé sur l'extraction du Cidial des fruits, sur la séparation successive de l'huile par le système biphase n-hexane-acétonitrile, sur la séparation du Cidial des insecticides hydrosolubles (par exemple Rogor) éventuellement employés avec le Cidial pour contrôler des autres insectes, sur la purification de la substance active par chromatographie et sur la microdistillation successive, dans les conditions bien déterminées, des composés phosphorés gênants, et enfin sur le dosage colorimétrique se basant sur le phosphore. On a largement utilisé le composé marqué au ^{32}P en vue d'analyser les rendements d'extraction, l'efficacité des diverses séparations et les rendements réalisables à l'aide des différentes techniques de purification. La chromatographie sur couches minces a procuré un moyen de contrôle très valable. La sensibilité de la méthode est telle qu'on peut déterminer 0.2 ppm de Cidial.

Ciodrin = Shell SD 4294

438 Chamberlain, W. F. THE METABOLISM OF P^{32}-LABELED SHELL SD-4294 IN A LACTATING EWE. J. econ. Ent. 57, 1 (1964) 119-21.

A study was made of the absorption, elimination, and metabolism of orally administered ^{32}P-labelled Shell SD-4294 (Ciodrin®), α-methylbenzyl 3-hydroxycrotonate dimethyl phosphate, in a lactating ewe. The peak radioactivity in both the blood and urine occurred at 6 h, which indicated a moderate rate of absorption but rather rapid elimination. Some 61-90% of the radioactivity in the urine was dimethyl phosphoric acid; the other metabolites occurred only in small quantities. The ratio of α to β isomer in the blood was similar to that in the original sample of SD-4294, whereas the very small residues in the milk consisted of β isomer only. (Auth.)

439 Chamberlain, W. F. THE METABOLISM OF P^{32}-LABELED CIODRIN IN A LACTATING GOAT. J. econ. Ent. 57, 3 (1964) 329-31.

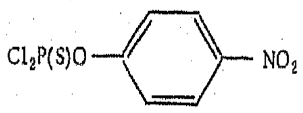
A study was made of the metabolism of ^{32}P-labelled Ciodrin® , α methylbenzyl 3-hydroxycrotonate dimethyl phosphate, by a dermally treated milk goat. Eleven percent of the applied dose was eliminated in the urine. Only minute quantities of radioactive material appeared in the faeces and milk. Dimethyl phosphoric acid accounted for 79.7-91.2% of the radioactive material in the urine. No radioactive material could be extracted from the blood, and the maximum true residue in the milk was only 0.20 ppb. (Auth.)

440 Potter, J. C., Burton, W. B. SYNTHESIS OF ALPHA-METHYLBENZYL 3-(DIMETHOXYPHOSPHINYLOXY)-CROTONATE LABELED WITH PHOSPHORUS-32 AND CARBON-14. J. agric. Fd Chem. 12, 5 (1964) 439-42.

The cis and trans isomers of α-methylbenzyl 3-(dimethoxyphosphinyloxy)-crotonate labelled with ^{32}P and ^{14}C have been prepared. The ^{14}C preparation was made by the exchange of methanol-^{14}C with the methoxy groups in trimethyl phosphite. The trimethyl-^{14}C phosphite was then reacted with α-methylbenzyl 2-chloroacetoacetate to form α-methylbenzyl 3-(dimeth-^{14}C-oxyphosphinyloxy)-crotonate. The ^{32}P preparation was made by the reaction of ^{32}P trichloride and methanol. The resulting trimethylphosphite-^{32}P was reacted to form α-methylbenzyl 4-(dimethoxyphosphinyl-^{32}P-oxy)-crotonate. The mixtures of cis and trans crotonates so prepared were separated from each other by columnar chromatography. The purity of the cis isomer was estimated to be 98-99%. The yield of the purified cis isomer was 32% in the ^{14}C preparation and 41% in the ^{32}P preparation. These compounds serve as insecticides (Essentially auth.)

441 T'u, T'ung-Yuan, Yao, Tu-Ch'ing, Ting, Hui-Chen, SYNTHESIS OF ISOTOPICALLY LABELED COMPOUNDS. III. SYNTHESIS OF THE ISOTOPICALLY LABELED INSECTICIDES 1605-^{14}C AND LURGO-^{32}P. Yuan. Tzu Neng 1 (1965) 56-59. (In Chinese)

Insecticide 1605-^{14}C, the synthesis of which has not yet been published, was produced experimentally from I and Me^{14}CH$_2$OH. I was prepared from S, PCl$_3$ and 1,4-HO(O$_2$N)C$_6$H$_4$ and treated with Me^{14}CH$_2$OH (prepared from Ba^{14}CO$_3$) to produce 1605-^{14}C in 67% yield and with a recovery of 60% of the radioactivity. Another insecticide, Lurgo-^{32}P, was prepared by a modified Dauterman method. The process involved the reaction of Na$_2$H^{32}PO$_4$ with P and S for the production of ^{32}P$_2$S$_5$, which was then treated with MeOH and NH$_3$ to yield (CH$_2$O)$_2$^{32}P(S)SNH$_2$; the latter was mixed with ClCH$_2$CONHMe



(I)

to produce the insecticide (CH$_2$O)$_2$P(S)SCH$_2$CONHMe. The yield was 75-7% and the radioactivity recovered calculated on the basis of Na$_2$H^{32}PO$_4$ was 26.4%. The results of paper chromatography and autoradiography indicated that the experimental products were identical with the commercial insecticides. (CA 64:1966, 4977c)

Phosphorus Heterocyclic Derivatives

Imidan

442 Chamberlain, W. F. A STUDY OF THE DERMAL TREATMENT OF A STEER WITH C^{14}-LABELED IMIDAN. J. econ. Ent. 58, 1 (1965) 51-5.

Absorption, excretion, and metabolism of ^{14}C-Imidan® (O, O-dimethyl S-phthalimidomethyl phosphorodithioate) were studied in a steer after dermal application. Imidan was moderately absorbed by the skin of the steer, since 9.6% of the applied dose was recovered in the excreta within 7 d. The compound was rapidly broken down in the blood system, as indicated by the small percentage of radioactivity which could be extracted with chloroform (less than 2%). The principal route of elimination of absorbed material was through the urine, in which nearly 8% of the applied dose was found within 7 d. Paper chromatography and electrophoresis of urine samples indicated that the primary degradation of Imidan in the steer occurred at the nitrogen atom, resulting in the almost exclusive production of phthalic and phthalamic acids. The presence of benzoic acid as a metabolite was not conclusively proved. The systemic action against common cattle grubs, Hypoderma lineatum (de Villers), is evidently the result of very low concentrations of Imidan or the oxygen analogue. (Auth.)

443 McBain, J.B., Menn, J.J. FATE OF ^{14}C [*N*-(MERCAPTOMETHYLPHTHALIMIDE *S*-(*O,O*-DIMETHYLPHOSPHORODITHIOATE)] (IMIDAN) IN RATS AND INSECTS. *Bull. ent. Soc. Am.* *11*, 3 (1965) 157. Abstr.46. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec.1965".

The insecticide Imidan is readily biodegraded in rats and insects via hydrolysis. These studies were carried out with Imidan labelled with ^{14}C in one of the carbonyl groups of the phthalimide moiety. Radiochromatography and other supporting analyses indicated that phthalamic and phthalic acids were the major detoxication products. (Abstr.)

444 Menn, J.J., McBain, J.B. METABOLISM OF PHTHALIMIDIMETHYL *O,O*-DIMETHYL PHOSPHORODITHIOATE (IMIDAN) IN COTTON PLANTS. *J. agric. Fd Chem.* *12*, 2 (1964) 162-6.

Imidan-^{14}C was readily absorbed by treated leaves but not translocated in the plant. The major acetone-extractable non-phosphate metabolites of Imidan consisted of phthalic and/or phthalamic acid, benzoic acid, and possibly one or more benzoic acid derivatives. These were determined by radiochromatography and autoradiography. Evolution of $^{14}CO_2$ and evidence for ^{14}C incorporation into plant constituents further indicated ready decarboxylation and metabolism of the phthalimide moiety of Imidan in the plant. The thiol analogue of Imidan was not discovered in cotton plant tissues; furthermore, the presence of a posthydrolysis phosphorothionate derivative on paper chromatograms indicated that hydrolysis of Imidan in vivo predominated over oxidation. (From auth.)

445 Menn, J.J., McBain, J.B., Ford, I.M. METABOLISM OF PHTHALIMIDOMETHYL-*O,O*-DIMETHYLPHOSPHORODITHIOATE (IMIDAN) IN WATER, INSECTS AND THE RAT. p.486 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul.1964". Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

The fate of ^{14}C-Imidan is described in aqueous media, *Blattella germanica*, and a male albino rat. Radioscans of chromatograms of internal acetone cockroach extracts indicated the presence of Imidoxon (phthalimidomethyl-*O,O*-dimethylphosphorothiolate) 2 h after topical application of ^{14}C-Imidan. An increasing build-up of non-acetone-extractable radioactivity accumulating in tissues with time was observed. The bound activity in tissues appears to exist in the form of a phthalic (PA) or phthalamic (PAA) acid derivative. A portion of the ^{14}C-activity from Imidan was presumably incorporated into carbohydrates and/or tryptophan and tyrosine. In both cockroach and rat the end products of Imidan metabolism apparently consist of phthalic acid (PA) or phthalamic acid (PAA) and derivatives, while in plants they are PA and benzoic or its derivative(s). PAA (alkaline pH) and PA (acid pH) are the aqueous hydrolysis end products. The nature of the derivatives is not yet established.

Dursban

446 Kenaga, E.E., Whitney, W.K., Hardy, J.L., Doty, A.E. LABORATORY TESTS WITH DURSBAN INSECTICIDE. *J. econ. Ent.* *58*, 6 (1965) 1043-50.

Dursban is the Dow trademark for *O,O*-diethyl *O*-3,5,6-trichloro-2-pyridyl phosphorothioate. It has a wide spectrum of insecticidal activity as shown by laboratory tests. Dursban is moderately residual on plant surfaces and is quite residual on inert surfaces such as wood, as judged by insecticidal properties. It is volatile enough to form insecticidal residues on surfaces of nearby untreated objects and is stable except under fairly rigorous conditions of alkalinity and acidity. Dursban has potentialities for the control of premise insects such as flies and cockroaches; stored-product insects; plant-damaging pests such as aphids, mites, and lepidopterous larvae; insect pests of sod and soil; mosquito larvae; and many other arthropods. In some vapour tests radioactive Dursban, ^{36}Cl-labelled at the 3 and 5 positions and analysed by liquid scintillation, was used.

Diazinon

447 Farnham, A.W., Lord, K.A., Sawicki, R.M. STUDY OF SOME OF THE MECHANISMS CONNECTED WITH RESISTANCE TO DIAZINON AND DIAZOXON IN A DIAZINON-RESISTANT STRAIN OF HOUSEFLIES. *J. Insect Physiol.* *11*, 1 (1965) 1475-88.

The toxicities of diazinon and diazoxon to two strains of *Musca domestica* (normal and resistant) were measured by injection and topical application. Both compounds were more toxic by injection. The difference in susceptibility by the two ways of poisoning was greater with the resistant than the susceptible flies because insecticide penetrates less readily into the resistant flies, as indicated by measurement of loss from the surface using radioactive diazinon (*O,O*-diethyl *O*-(2-isopropyl-4-methyl-6-pyrimidyl phosphorothioate) labelled in the ethyl groups with ^{14}C). Resistance of both strains increased with age; ^{14}C-diazinon penetrated the cuticle of younger flies more rapidly than of older flies. Even when injected, more diazinon or diazoxon was needed to kill resistant flies than the susceptible, indicating that penetration was not the only reason for resistance. ^{14}C-diazinon was decomposed more efficiently by resistant than by susceptible flies.

448 Getzin, L.W. THE RECOVERY OF C^{14}-DIAZINON AND ITS C^{14}-LABELED METABOLITES FROM SOIL. *Bull. ent. Soc. Am.* *10*, 3 (1964) 176. Abstr.

Methods were developed for recovery of ^{14}C-metabolites from soils. Radioactive chloroform-soluble components, water-soluble components, volatilized diazinon and carbon dioxide were detected. Residual life of diazinon varied from 16 weeks to over 32 weeks. A major part of the ^{14}C was eventually evolved as carbon dioxide.

See also:

84 The effect of malathion on the metabolism of amino acids in the German cockroach *Blattella germanica*. (Mansingh, A., 1965)

336 Studies on the rate of penetration of diazinon, dieldrin and malathion in resistant and susceptible *M. domestica*. (Crothers, W.C., Forgash, A.J., 1964)

363 Absorption and distribution of DDT in the boll weevil and the influence of synergists on toxicity. (Land, J.D., 1963/64)

460 Metabolism of carbamate and organophosphate insecticides by cattle and poultry and associated residues in livestock products. (Buttram, J.R., 1964)

5. Carbamates

Zectran

449(2) Williams, E., Meikle, R.W., Redemann, C.T. THE IDENTIFICATION OF METABOLITES OF ZECTRAN® INSECTICIDE IN DOG URINE. AED-Conf.133-38, 1963, 12p. Presented at the "145th National Meeting of the American Chemical Society, New York, 8-13 Sep.1963".

Five-months-old beagles were used, preconditioned by feeding inactive Zectran in their rations, which was interrupted by a total of 14 feedings of tagged Zectran. The study was carried out subsequent to a study on Zectran metabolites in broccoli (ref.465) in order to determine whether there are metabolites in the plant which are not present in the animal. No unhydrolysed 4-dimethylamino-3,5-xylyl methylcarbamate was detected. 4-dimethylamino-3,5-xylenol was found, and 4-dimethylamino-3,5-xylenol and 2,6-dimethylhydroquinone occurred as water-soluble conjugates.

450 Williams, E., Meikle, R.W., Redemann, C.T. IDENTIFICATION OF METABOLITES OF ZECTRAN INSECTICIDE IN DOG URINE. *J. agric. Fd Chem.* *12*, 5 (1964) 457-61.

A metabolic study is described. Radioactive Zectran, 4-dimethylamino-3,5-xylyl-α^{3}, 3-$^{14}C_2$-methylcarbamate (specific activity 0.031 mCi/mM) was used. Free 4-dimethylamino-3,5-xylenol and water-soluble conjugates of 4-dimethylamino-3,5-xylenol and 2,6-dimethyl-hydroquinone are identified as metabolites.

451 Williams, E., Meikle, R.W., Redemann, C.T. RADIOSYNTHESIS OF CARBON-14-LABELED 4-DIMETHYLAMINO-3,5-XYLYL METHYLCARBAMATE. *J. agric. Fd Chem.* *13*, 3 (1965) 211-13.

4-dimethylamino-3,5-xylyl methylcarbamate was labelled with ^{14}C at three locations. The carbonyl group was labelled in 46% yield based on radioactivity by the conversion of acetic anhydride-1,1-^{14}C to methyl isocyanate and reaction of this with 4-dimethylamino-3,5-xylenol. The 1-position in the ring was labelled in 3% yield by the addition of carbon dioxide-^{14}C to the di-Grignard reagent of 1,5-dibromo-2,4-dimethylpentane and catalytic conversion to 3,5-xylenol. This was followed by nitrosation, hydrogenation, methylation, and reaction with methyl isocyanate. The di-Grignard reagent was prepared by a seven-step synthesis starting with diethyl malonate. Both the 3-position in the ring and the 3-methyl group were labelled in 10% yield by the reaction of acetaldehyde-1,2-^{14}C with ethylacetoacetate and conversion to 3,5-xylenol. (Auth.)

452(2) Williams, E., Meikle, R.W., Redemann, C.T. THE IDENTIFICATION OF METABOLITES OF ZECTRAN ® INSECTICIDE IN BROCCOLI. AED-Conf. 133-39, 1963, 12p. Presented at the "145th National Meeting of the American Chemical Society, New York, 8-13 Sep. 1963".

The following metabolites were identified: 4-dimethylamino [3,α^{3}-^{14}C]3,5-xylyl methylcarbamate, 4-dimethylamino-3,5-sylenol, 2,6-dimethylhydroquinone, 2,6-dimethyl-*p*-benzoquinone, 4-dimethylamino-3,5-dimethyl-*o*-benzoquinone. No conjugated 4-dimethylamino-3,5-dimethylpyrocatechol was found but 4-dimethylamino-3,5-xylenol and 2,6-dimethylhydroquinone were found as water-soluble conjugates. It was shown that metabolites of this pesticide had been incorporated into lignin.

453 Williams, E., Meikle, R.W., Redemann, C.T. IDENTIFICATION OF METABOLITES OF ZECTRAN INSECTICIDE IN BROCCOLI. *J. agric. Fd Chem.* *12*, 5 (1964) 453-7.

At the appearance of the first flowers, Zectran was applied to broccoli by dissolving 4 mg of 4-dimethylamino-3,5-xylyl-α^{3}-3-$^{14}C_2$-methylcarbamate in 50 µl of corn oil and streaking the stem immediately below a flower cluster. Broccoli was harvested 10 d later. Counting, chromatographic, and fractionation procedures used in studying the metabolism of Zectran are described in detail. In addition to a small amount of Zectran, the following metabolites were found to be present in the broccoli flower: 4-dimethylamino-3,5-xylenol, 2,6-dimethylhydroquinone, 2,6-dimethyl-*p*-benoquinone, and 4-dimethylamino-3,5-dimethyl-o-benzoquinone. The zylenol was found in both free and conjugated form, but the hydroquinone derivative was detected only as a water-soluble conjugate. Evidence is presented which suggests that metabolites of this pesticide have been incorporated into lignin.

Carbaryl

454 Dorough, H.W., Casida, J.E. NATURE OF CERTAIN CARBAMATE METABOLITES OF THE INSECTICIDE SEVIN. *J. agric. Fd Chem.* *12*, 4 (1964) 294-304.

The chemical nature of Sevin metabolites formed by rat liver microsomes fortified with reduced nicotinamide-adenine dinucleotide phosphate and by cockroaches and house flies was examined. Metabolites tentatively identified were 1-naphthyl *N*-hydroxymethylcarbamate, 4-hydroxy-1-naphthyl *N*-methylcarbamate, and 5-hydroxy-1-naphthyl *N*-methylcarbamate. At least two unidentified metabolites had the C–O–C(O)–N–C structure intact. Hydrolysis yielded 1-naphthol and at least two unidentified metabolites lacking the carbamyl group. These eight metabolites, five of which were carbamates, were formed by the liver microsomes and insects. Certain of these metabolites appeared in the milk of a goat treated orally with Sevin-carbonyl-^{14}C. Most of these metabolites were absent in plants injected with Sevin-^{14}C where carbonly-^{14}C, methyl-^{14}C, or naphthyl-^{14}C samples of Sevin yielded water-soluble persisting metabolite(s). Similar, but more limited studies, are considered with Bayer 39007 (*o*-isopropoxyphenyl *N*-methylcarbamate). Bayer 39007-carbonyl-^{14}C and three labelled samples of Sevin were tested on *Musca domestica* L. and *Periplaneta americana* (L.). Bioassays on metabolites of Bayer 39007 indicated reduced biological activity compared with the original insecticides.

455 Knaak, J.B., Tallant, M.J., Bartley, W.J., Sullivan, L.J. THE METABOLISM OF CARBARYL IN THE RAT, GUINEA PIG, AND MAN. *J. agric. Fd Chem.* *13*, 6 (1965) 537-43.

The metabolic fate of methyl-^{14}C, carbonyl-^{14}C, and naphthyl-^{14}C-labelled carbaryl in the rat and guinea pig was investigated. The overall recovery of the naphthyl, carbonyl, and methyl label was, respectively, 95, 99, and 91% of dose. Tissue residues (2-3% of dose) were found only in the case of methyl-labelled carbaryl. The metabolites identified were 4-(methylcarbamoyloxy)-1-naphthyl glucuronide, 1-naphthyl glucuronide, 4-(methylcarbamoyloxy)-1-naphthyl sulphate, and 1-naphthyl sulphate. Evidence is presented for the possible direct conjugation of carbaryl with glucuronic acid to form 1-naphthyl methylcarbamate *N*-glucuronide and 1-naphthyl methylimidocarbonate *O*-glucuronide. The assay of carbaryl, carbaryl derivatives, and metabolites in water by fluorimetry was investigated in conjunction with ^{14}C chromatographic studies and the method applied to the analysis of urines from men exposed to carbaryl dust. The only detectable metabolites present were 1-naphthyl glucuronide and sulphate. (Auth.)

456 Williams, M.W., Batjer, L.P. SITE AND MODE OF ACTION OF 1-NAPHTYL *N*-METHYLCARBAMATE (Sevin) IN THINNING APPLES. *Proc. Am. Soc. hort. Sci.* *85* (1964) 1-10.

When 1-naphthyl *N*-methylcarbamate (Sevin) was applied to Red Delicious spur leaves only, a slight thinning response resulted, and when applied to fruit only, heavy thinning occurred. By applying both ring- and side-chain-labelled ^{14}C-Sevin to spur leaves, it was found that movement of Sevin in the vascular tissue was slow, and after extended periods of time little activity was detected in the seeds. With either leaf or fruit applications, radioactivity was present mainly in the vascular tissues of the fruit. When a fruit was dipped in ^{14}C-Sevin, activity appeared in the vascular tissue in a short time. The vascular tissue of the fruit is considered to be the site of action of Sevin. Extraction and analysis of fruit and leaf tissues treated with ^{14}C-Sevin showed that most of the recovered ^{14}C was in the methylene chloride fraction and a small amount was present in the ethanol-water fraction. Paper chromatography of the methylene chloride fraction showed only the presence of 1-naphthyl *N*-methylcarbamate. The main component of the ethanol-water fraction, though unidentified, contained both the naphthol ring and the carbonyl carbon of the original Sevin molecule. It is proposed that Sevin interferes with the movement of vital growth factors in the vascular tissues of the fruit. Such interference prevents the growth of weak fruits, and abscission, either with or without seed abortion, results. (Auth.)

Dimetilan

457 Zubairi, M.Y. METABOLISM OF THE CARBAMATE INSECTICIDE DIMETILAN-C^{14} 1-DIMETHYLCARBAMOYL-5-METHYL-3-PYRAZOLYL DIMETHYLCARBAMATE-(CARBONYL-C^{14}). *Bull. ent. Soc. Am.* *10*, 3 (1964) 163. Abstr. 47

Dimetilan was rapidly metabolized by house flies and American and German cockroaches. Five of the metabolites from the American cockroach were purified by column and thin layer chromatography and the major one appeared to be the *N*-methyl, *N*-hydroxymethylcarbamate of dimetilan. The nature of the other carbamate metabolites will be discussed.

458 Zubairi, M.Y., Casida, J.E. DETOXICATION OF DIMETILAN IN COCKROACHES AND HOUSE FLIES. *J. econ. Ent.* *58*, 3 (1965) 403-9.

Dimetilan-^{14}C (2-dimethylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate-carbonyl-^{14}C) is rapidly metabolized in *Blattella germanica* (L.) to yield nine ^{14}C-labelled metabolites. Six of these metabolites are formed also in *Periplaneta americana* (L.) and four in *Musca domestica* L. Metabolites tentatively identified include 2-dimethylcarbamoyl-3-methyl-5-pyrazolyl *N*-hydroxymethyl, *N*-methylcarbamate and 2-methylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate. Three other metabolites are unidentified *N*-hydroxymethyl derivatives. None of these metabolites was more toxid to house flies than dimetilan, but one formaldehyde-yielding metabolite was almost as toxic as the parent material. Many metabolites were synergized in their toxicity by sesamex as was the case also with dimetilan and certain of its analogues. *N*-methyl hydroxylation appears to be a major factor in the detoxication of dimetilan in insects. (Auth.)

Various Methylcarbamates

459 Abdel-Wahab, A.M. DEGRADATION AND PERSISTENCE OF EIGHT SUBSTITUTED PHENYL METHYLCARBAMATE-CARBONYL-C^{14} INSECTICIDES ON BEAN FOLIAGE. *Bull. ent. Soc. Am.* *11*, 3 (1965) 156. Abstr. 39. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Matacil and Zectran were each decomposed on exposure to sunlight to more than ten carbamates: 4-dimethylamino, 4-methylformamido, 4-amino, and 4-formamido analogues were identified as the major degradation products. Mesurol was oxidized to its sulphoxide and sulphone derivatives. Carbaryl was the most persistent compound and Baygon and UC 10854 the least while Banol and HRS-1422 were of intermediate stability. (Abstr.)

460 Buttram, J.R. METABOLISM OF CARBAMATE AND ORGANOPHOSPHATE INSECTICIDES BY CATTLE AND POULTRY AND ASSOCIATED RESIDUES IN LIVESTOCK PRODUCTS. *Diss. Abstr.* *24*, 10 (1964) 4319.

^{32}P-labelled Bayer 22408 (*O*,*O*-diethyl *O*-naphthalimido phosphorothioate) was applied dermally as a 0.5% emulsion to two Holstein dairy cows. Detectable quantities of the intact insecticide were isolated from milk for the first 6 d after treatment. Bayer 22408 equivalents in the milk were about 10 times higher than the actual Bayer 22408. The oxygen analogue of the parent compound was not present in milk, but it was the predominant non-hydrolyzed product in the faeces. The faecal metabolites were toxic to stable fly (*Stomoxys calcitrans* (L.)) larvae, but not to house fly (*Musca domestica* L.) larvae. Sevin ® (1-naphthyl *N*-methylcarbamate) was applied dermally to cows (head) under different conditions and milk tested for residues at given intervals. — Six steers were treated intramuscularly (hip or neck) with ^{32}P-labelled Co-Ral ® (*O*,*O*-diethyl *O*-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate). The Co-Ral did not diffuse from the point of injection to surrounding tissues in an even pattern but moved along bundles of muscle fibre. For example, analysis of biopsy samples revealed that certain portions of the muscle contained 500 times more Co-Ral than an adjoining section; 3 d after treatment, 85% or more of the injected dose had moved from the site of injection. There was a small amount of the oxygen analogue of Co-Ral present in the 3 and 7 d biopsy samples. The cumulative percentage of administered radioactivity that appeared in the faeces of steers by 14 d post-treatment ranged from 0.7 - 7.6%. Some Co-Ral escaped degradation and appeared in the faeces as non-hydrolysed materials. There were no gross histopathological effects due to treatment. The anthelminthic activity of Co-Ral administered intramuscularly was not encouraging. Recoveries of Sevin, Co-Ral, Bayer 22408, Kepone ® (decachlorooctahydro-1,3,4-metheno-2H-cyclobuta [cd] pentalen-2-one), Bayer 29493 (*O*,*O*-dimethyl *O*-[4-(methylthio)-*m*-toly] phosphorothioate), and Ruelene ® (*O*-4-*tert*butyl-2-chlorophenyl *O*-methyl methylphosphoramidate), from milk ranged from 87 to 97%. Ruelene, Bayer 22408, and Bayer 29493 were stable under in vitro conditions in raw milk for periods up to 14 d after incubation, but by 3 d after incubation, some Co-Ral remained in the milk residue following acetonitrile extraction. Ruelene was rapidly metabolized by laying hens receiving the compound in the diet for 7 d at 100 ppm. The in vivo degradation of Ruelene proved complex, involving enzymatic attack at the two ester groupings and the amide bond of the molecule.

461 Casida, J.E., El-Wahab, A.A., Gillett, J., Krishna, J.-G., Kuhr, R., Oonnithan, E., Shrivastava, S., Miskus, R. PROGRESS REPORT ON THE COMPARATIVE FATE OF EIGHT SUBSTITUTED-PHENYL *N*-METHYLCARBAMATE-C^{14} INSECTICIDES. PARTS I and II. *Bull. ent. Soc. Am.* *10*, 3 (1964) 163. Abstr. 48, 49.

Eight *N*-methylcarbamates of interest as potential commercial insecticides were radio-labelled and their fate examined on and in bean plants, in rats and house flies, and in a rat liver microsome hydroxylation enzyme system. Oxidation, hydroxylation, hydrolysis and conjugation resulted in the appearance of a great variety of products with each carbamate.

462 El-Sebay, A.H., Metcalf, R.L., Fukuto, T.R. CARBAMATE INSECTICIDES: SYNERGISM BY ORGANOTHIOCYANATES. *J. econ. Ent.* *57*, 4 (1964) 478-82.

Isobornyl thiocyanoacetate and related thiocyanates were shown to be highly synergistic when used in combination with several insecticidal carbamates against the house fly, *Musca domestica* L. Synergism comparable to that obtained with commercially available methylenedioxyphenyl synergists was demonstrated against susceptible and carbamate-resistant flies. Experiments with ^{14}C-labelled carbamates showed that the synergism involved inhibition of the biochemical detoxication of the carbamate within the body of the fly. ^{14}C-ring-labelled phenyl *N*-methylcarbamate (specific activity 1.5 mCi/mM) was prepared by adding ring-labelled phenol to an excess of methyl isocyanate in a capillary tube. It was shown to be > 99% pure by paper chromatography. ^{14}C-labelled (ring and 3,5-methyl groups) Zectran was obtained commercially, shown to be ~90% pure by paper chromatography.

463 Georghiou, G.P. EFFECTS OF CARBAMATES ON HOUSE FLY FECUNDITY, LONGEVITY, AND FOOD INTAKE. *J. econ. Ent.* *58*, 1 (1965) 58-62.

Topical application of sublethal but knockdown-inducing doses of Isolan ® (1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate) to house flies, *Musca domestica* L., resulted in substantial reduction of egg laying but did not affect mating, longevity, or egg fertility. Significant reductions in fecundity were obtained whether the insecticide was applied before or after mating and whether the insects had prior access to milk or not. Increasing the doses above the sublethal level had a greater repressing effect on fecundity but did not cause complete sterility. Thus, a sublethal dose of 0.3 μg per fly reduced total egg production by 35.8%, while doses of 0.6 and 1.0 μg, representing LD10 and LD30 levels, respectively, reduced egg production by 43.1% and 77.2%, respectively. The effect of the treatments was long lasting: the daily egg production in flies treated with 0.6 μg did not equal that of the control until the 19th d after treatment; by the use of ^{32}P milk it was found that treated flies consumed as much as 51.8% less milk than the untreated flies even 8 d after treatment. Tests with other carbamates indicated that while physostigmine and Pyrolan ® (3-methyl-1-phenyl-5-pyrazolyl dimethylcarbamate) had no effect on fecundity, dimetilan, carbaryl, Bayer 39007 (*O*-isopropoxyphenyl methylcarbamate) and Hercules 5727 (m-isopropylphenyl methylcarbamate) caused significant reduction in egg production. Although the precise nature of the interaction between the insecticide and the physiological processes that are significant in reproduction remains unresolved, the available evidence indicates that cholinesterase inhibition is not directly responsible for the suppression of egg production.

464 Gheorghiou, G.P. STUDIES ON RESISTANCE TO CARBAMATES IN MOSQUITOES. *Bull. ent. Soc. Am.* *10*, 3 (1964) 174. Abstr.

Selection of *Culex pipiens quinquefasciatus* and *Anopheles albimanus* with *O*-isopropoxyphenyl and *M*-isopropylphenyl *N*-methylcarbamates resulted in low levels of resistance to selective agents and to related carbamates. Tests with ^{14}C-labelled *O*-isopropoxyphenyl *N*-methylcarbamate indicated resistance is due to enhanced detoxication mechanisms. Appropriate crosses showed this resistance to be of polygenic nature.

465 Metcalf, R.L., Fukuto, T.R. EFFECTS OF CHEMICAL STRUCTURE ON INTOXICATION AND DETOXICATION OF PHENYL *N*-METHYLCARBAMATES IN INSECTS. *J. agric. Fd Chem.* *13*, 3 (1965) 220-31.

A review paper, dealing primarily with 15 years of research by the authors on the chemistry and mode of activation of substituted phenyl *N*-methylcarbamate insecticides. The biological activites of some 130 compounds are described. Detailed consideration is given to the interaction of these carbamates with the active site of insect cholinesterase. Detoxication mechanisms are described in relation to synergism and insect resistance. Some unpublished work in which ^{14}C-labelled carbamates were used confirmed that detoxication by resistant flies is the primary factor conferring resistance. In the experiments, ^{14}C(ring and 3,5-methyl-labelled) 4-dimethylamino-3,5-xylenyl *N*-methylcarbamate was injected into the abdomens of flies; after appropriate intervals, the labelled metabolites were extracted and separated by paper chromatography. The results are tabulated and show the pronounced effect of a 1½-h pretreatment with piperonyl butoxide in reducing the detoxication of the carbamate within the fly. Other cited studies also employed radioisotopes.

466 O'Brien, R.D. REACTION OF CARBAMATES WITH CHOLINESTERASE. *Bull. ent. Soc. Am.* *10*, 3 (1964) 163. Abstr. 46.

Evidence obtained by kinetic analysis of recovery from inhibition, and from the products following reaction of a ring-labelled carbamate with purified cholinesterase, supports a carbamoylation mechanism for inhibition. (Abstr.)

467 Oonithan, E.S. METABOLISM OF METHYLCARBAMATE INSECTICIDE CHEMICALS BY RAT LIVER ENZYME SYSTEMS. Bull. ent. Soc. Am. 11, 3 (1965) 158. Abstr. 66. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Metabolism of eight ^{14}C-labelled N-methyl- and two ^{14}C-labelled N,N-dimethylcarbamate insecticides by a microsome-$NADPH_2$ system proceeds at a rate dependent on the nature of the aryl of heterocyclic ring substituents. Certain of the carbamate metabolites formed were more potent cholinesterase inhibitors than the parent compound. (Abstr.)

See also:

363 Absorption and distribution of DDT in the boll weevil and the influence of synergists on toxicity. (Land, J.D., 1963/64)

435 Penetration of insecticides through rat skin. (O'Brien, R.D., Dannelley, C.E., 1965)

6. Pyrethroids

Pyrethrins and Cinerins

468 Chang, Shen Chin, Kearns, C.W. METABOLISM IN VIVO OF ^{14}C-LABELLED PYRETHRIN I AND CINERIN I BY HOUSE FLIES WITH SPECIAL REFERENCE TO THE SYNERGISTIC MECHANISM. J. econ. Ent. 57, 3 (1964) 397-404.

Randomly labelled ^{14}C-pyrethrin I (PI*) and ^{14}C-cinerin I (CI*) were used alone and in combination with sesamex in the study of their metabolism by house flies, Musca domestica L., in vivo. The metabolisms of PI* and of CI* follow a similar pattern and the difference is quantitative rather than qualitative. The difference in potency of PI* and CI* was due to the rate of detoxification. There is no difference in the absorption rate. More than 96% of the absorbed dose of CI* or PI* was detoxified 4 h after topical application. The mechanism of synergism was explained by the fact that the synergist prevents the detoxification of the absorbed pyrethroids although the absorption of pyrethroids is less in the presence of sesamex than in its absence. Five metabolites plus chrysanthemic acid each from PI* and CI* have been isolated and partially characterized. The amount of free chrysanthemic acid never exceeds 2.6% of the applied dose. The direct hydrolysis of the ester linkage in either molecule is not a major detoxification mechanism. Of five metabolites, three showed and intact chrysanthemic acid moiety and ester linkage. The detoxification process is apparently initiated on the keto-alcohol moiety while the acid moiety and the ester linkage are still intact. Further breakdown of the altered molecule into more polar compounds is indicated. (Auth.)

Chrysanthemumic Acid

469 Nishizawa, Y., Casida, J.E. SYNTHESIS OF d-trans-CHRYSANTHEMUMIC ACID-1-C^{14} AND ITS ANTIPODE ON A SEMIMICRO SCALE. J. agric. Fd Chem. 13, 6 (1965) 525-7.

dl-trans-Chrysanthemumic acid-1-^{14}C was prepared in 45% yield from 4 mM of ethyl glycinate-1-^{14}C. Yield of the trans-acid was increased by isomerization of methyl cis-chrysanthemumate-1-^{14}C with sodium tert-amylate. Geometrical isomers of the acid were separated by column chromatography, and optical isomers of the trans-acid were resolved as a quinine salt for the l-isomer and an l-α-methylbenzylamine salt for the d-isomer. Over-all yields of trans-chrysanthemumic acids-1-^{14}C, based on radioactivity from ethyl glycinate-1-^{14}C (2.7 mCi/mM), were: 22.8% of impure d-isomer, 10.4% of pure l-isomer, and 7.0% of pure d-isomer with specific activities of 1.3 - 2.7 mCi/mM. (Auth.)

7. Nicotine Alkaloids (including Anabasine and Related Compounds)

470 Alworth, W.L., DeSelms, R.C., Rapoport, H. THE BIOSYNTHESIS OF NICOTINE IN Nicotiana glutinosa FROM CARBON-14 DIOXIDE. J. Am. Chem. Soc. 86 (1964) 1608-16.

Plants of N. glutinosa were grown in an atmosphere containing $^{14}CO_2$ for periods varying from 2 h, the shortest time at which incorporation of radioactivity into nicotine could be detected, to 12 h. The nicotine, isolated separately from the root and aerial portions, was degraded, and the activity in the pyridine ring, the N-methyl group, and carbon-2' of the pyrrolidine ring was determined. These data were correlated in terms of (1) the rate of incorporation of CO_2 into nicotine, (2) the site of nicotine syntheses, (3) the relative rate of N-methyl syntheses, and (4) the relative rate of syntheses of the pyridine and pyrrolidine rings. The conclusions thus reached compared with those in the literature derived from grafting experiments and from feeding precursors other than CO_2. Evidence is presented for independent nicotine synthesis in both root and aerial portions, and some questions are raised concerning the glutamate-symmetrical intermediate hypothesis for pyrrolidine ring biosynthesis. (Auth.)

471 Alworth, W.L., Liebman, A.A., Rapoport, H. THE BIOSYNTHESIS OF NICOTINE IN Nicotiana glutinosa FROM CARBON-14 DIOXIDE. FORMATION OF THE PYRROLIDINE RING. J. Am. chem. Soc. 86 (1964) 3375-81.

Radioactive nicotine, isolated from the root and aerial portions of N. glutinosa after a 6 h exposure to $^{14}CO_2$, was degraded and the activity determined in the pyridine ring, the N-methyl group, and C-2' and C-5' of the pyrrolidine ring. The results support previous conclusions reached from $^{14}CO_2$ feedings. In addition, equal activity was found at C-2' and C-5', consistent with the glutamate-symmetrical intermediate hypothesis. However, the labelling pattern required is not derivable from any of the known glutamate biosyntheses. An attempt was made to reconcile the various data by suggesting a new glutamate biosynthesis. (Auth.)

472 Andersson, G., Hansson, E., Schmiterlöw, C.G. GASTRIC EXCRETION OF C^{14}-NICOTINE. Experientia 21, 4 (1965) 211-13.

A quantitative analysis of the gastric excretion of ^{14}C-nicotine and its metabolites is described. Radiochemically pure ^{14}C-nicotine of a specific activity of 66 μCi/mg was prepared. The gastric excretion of radioactive nicotine from the stomach mucosa into the stomach was tested for mice, rats, and cats, by autoradiography and by measuring the radioactivity. Perfusion of rat stomach in situ resulted in pH-dependent nicotine excretion. The excreted radioactivity was traced to nicotine and to the degradation product cotinine.

473$^{(2)}$ Appelgren, L.-E., Hansson, E., Schmiterlöw, C.G. THE ACCUMULATION AND METABOLISM OF C^{14}-LABELLED NICOTINE IN THE BRAIN OF MICE AND CATS. Acta physiol. scand. 56 (1962) 249-57.

Whole-body autoradiograms of mice injected intravenously with (−)-nicotine-methyl ^{14}C (I) show an initial accumulation of radioactivity in the central nervous system. This high concentration of I and (or) its metabolites in the brain disappears within 30 min to 1 h. Autoradiograms of cat brain show a similar accumulation of radioactivity following injection of I. Only one I metabolite, cotinine, was found to occur in the brains of mice and cats. The subsequent disappearance of radioactivity from the central nervous system indicates a rapid outflow of I and (or) its metabolites. This pattern of rapid uptake followed by outflow is peculiar to the brain; in whole-body autoradiograms there is still a high level of radioactivity in other organs (liver, stomach, intestine, kidney, and salivary gland) when the brain is almost free of radioactivity. It is suggested that since cotinine has a much lesser pharmacological action than I, it may also have less affinity for tissues of the central nervous system. As cotinine is an oxidized form of I, it should be more polar and thus less fat soluble. There is significant accumulation of radioactivity in the ganglion cells. The I receptors in brain may not be able to serve as receptors for cotinine. This could explain the more diffuse distribution of radioactivity in the brain 30 min after the injection of I, when the major part of the radioactivity is present as ^{14}C in cotinine. (CA 58:1963, 14585g)

474 Bowman, E.R., Hansson, E., Turnbull, L.B., McKennis, H., Jr., Schmiterlöw, C.G. DISPOSITION AND FATE OF (−)-COTININE-H^{3} IN THE MOUSE. J. Pharmacol. exp. Ther. 143, 3 (1964) 301-8.

Intravenously injected cotinine-^{3}H in the mouse was evenly distributed among various tissues, except for a high concentration in excretory organs. The metabolites demethylcotinine, hydroxycotinine, and 3-pyridylacetic acid were present in the urine. (CA 60:1964, 15004g)

475 Gholson, R. K., Chandler, J. L. R., Yang, K. S., Waller, G. R. NICOTINE BIOSYNTHESIS. Fedn Proc. Fedn Am. Socs exp. Biol. 23, 2, Pt. I (1964) 528. Abstr. 2556. Presented at the "48th Annual Meeting, Chicago, 12-17 Apr. 1964".

Nicotinic acid-2, 3, 7-^{14}C and quinolinic acid-2, 3, 7, 8-^{14}C were fed to young Nicotiana tabacum L. plants via a newly regenerated root system. Incorporation of these compounds into nicotine was 10% and 5.6% respectively. All ^{14}C from both precursors was located in the pyridine ring of the alkaloid. Nicotine isolated from plants fed nicotinic acid-2, 3, 7-^{14}C was oxidized to nicotinic acid without loss of specific activity. This nicotinic acid was injected into castor seedlings and ricinine isolated 96 h later. Degradation of this ricinine showed that only carbons 2 and 3 were radioactive. These results indicate nicotine formation involves a decarboxylation of nicotinic acid with attachment of the pyrrolidine ring to the position of the pyridine ring formerly occupied by the carboxyl group of nicotinic acid. A free symmetrical pyridine derivative cannot be involved. A particulate enzyme catalyzing decarboxylation of nicotinic acid is present in the tobacco roots, but not in tobacco leaves or in castor roots. Nicotinic acid ribotide does not appear to be a substrate and decarboxylation of free nicotinic acid is not stimulated by the addition of ATP, PRPP, NAD, NADH, CoA, putricine or ornithine. (Abstr.)

476 Flecker, I., Byerrum, R. U. THE ROLE OF GLYCEROL IN THE BIOSYNTHESIS OF THE PYRIDINE MOIETY OF NICOTINE. J. biol. Chem. 240, 10 (1965) 4099-4102.

A new degradation of the pyridine ring of nicotine is described which permits isolation of each ring carbon. Plants were fed glycerol-2-^{14}C and glycerol-1, 3-^{14}C for this purpose. The location of the ^{14}C in the ring, with the use of this degradation, provides evidence that the carbon atoms of glycerol were incorporated in toto into positions 4, 5, and 6 of the pyridine ring. Over 98% of the ^{14}C in the pyridine ring derived from glycerol-2-^{14}C was in carbon atom after a 4-h metabolism period. The pyridine ring of nicotine formed from glycerol-1, 3-^{14}C had 68% of the radioactivity divided between carbon atoms 4 and 6, whereas carbon 5 had about 2% of the radioactivity. Some ^{14}C from glycerol-1, 3-^{14}C was found in positions 2 and 3 of the pyridine ring. It is proposed that this incorporation results from conversion of labelled glycerol, by way of glycolysis and the tricarboxylic acid cycle, to methylene-labelled succinate which has previously been found to yield the pyridine ring of nicotine labelled in positions 2 and 3. (Essentially auth. summary)

477 Griffith, G. D., Griffith, T. METABOLISM OF THE METHYL GROUP OF NICOTINE IN Nicotiana rustica. Pl. Physiol., Lancaster 39, 6 (1964) 970-73.

Experiments were carried out on tobacco plants with and without roots. The rate of methyl group metabolism in N. rustica L. var. humilis was studied by hydroponically feeding mature plants either methionine-methyl-^{14}C or nicotine-methyl-^{14}C and isolating nicotine from the plants after from 6 h - 9 d. Following methionine feeding, a major portion of the ^{14}C entering the methyl group of nicotine did so within 2 d. It appears that transmethylation from methionine to nicotine as well as catabolism of the ring structure of nicotine occurs almost exclusively in root tissue.

478 (2) Hansson, E., Schmiterlöw, C. G. PHYSIOLOGICAL DISPOSITION AND FATE OF C^{14}-LABELLED NICOTINE IN MICE AND RATS. J. Pharmacol. exp. Ther. 137 (1962) 91-102.

Nicotine-methyl-^{14}C injected intramuscularly or intravenously into mice was distributed throughout all important organ tissues within a few minutes. Concentrations were especially high in the brain, adrenal medulla, stomach wall, and kidney. After 30 min or more the distribution picture changed, apparently because of rapid metabolism of the nicotine. Rat experiments gave similar results. A large amount of nicotine was excreted into the stomach via the fundus mucosa and 2-3% of the dose was excreted in the bile in rats during a 6 h period. From 60 - 80% of the radioactivity was found in the urine of mice and rats and 8-15% in the exhaled CO_2 of mice in the 24 h following the injection. Chromatographic examination of the urine radioactivity revealed at least eight metabolites of nicotine including continine and hydroxycotinine. (CA 57; 1962, 13126i)

479 Hansson, E., Hoffmann, P. C., Schmiterlöw, C. G. METABOLISM OF NICOTINE IN MOUSE TISSUE SLICES. Acta physiol. scand. 61 (1964) 380-92.

Nicotine metabolism was investigated in tissue slices of various organs of the mouse using nicotine-methyl-^{14}C and thin-layer chromatography. Liver, kidney and lung were found to metabolize nicotine, while brain, diaphragm, spleen, stomach, small intestine, and adrenal did not. The metabolic products identified were cotinine, γ-(3-pyridyl)-γ-oxo-N-methylbutyramide, hydroxycotinine, and $^{14}CO_2$. Two unidentified products were separated chromatographically.

480 Leete, E., Friedman, A. R. BIOSYNTHESIS OF NICOTINE ALKALOIDS. X. THE INCORPORATION OF GLYCEROL 2-^{14}C INTO THE PYRIDINE RING OF ANABASINE. J. Am. chem. Soc. 86 (1964) 1224-26.

Nicotiana plants fed ^{14}C labelled glycerol formed anabasine with 38% of the radioactivity in the pyridine ring. Degradation studies showed high radioactivity in the C-2 C-3 and C-5 positions of the molecule and little in the C-4 and C-6 positions. These findings are consistent with the idea that nicotinic acid, a precursor of the pyridine ring is synthesized in the formation of anabasine. (BA 46: 1965, 58995)

481 Leete, E., Gros, E. G., Gilbertson, T. J. THE BIOSYNTHESIS OF ANABASINE. ORIGIN OF THE NITROGEN OF THE PIPERIDINE RING. J. Am. chem. Soc. 86, 18 (1964) 3907-08.

A mixture of lysine-2-^{14}C and lysine-ε-^{15}N was fed to a sterile culture of excised Nicotiana glauca roots. In a 2nd experiment a mixture of lysine-2-^{14}C and lysine-α-^{15}N was administered. One month after feeding the tracers, the roots were harvested and extracted with $CHCl_3$, affording nicotine and anabasine (I) which were separated by chromatography over Al_2O_3. I was then degraded to determine the distribution of ^{14}C and ^{15}N in the molecule. Oxidation with $KMnO_4$ gave nicotinic acid, assayed as its Me ester. Decarboxylation of the acid with CaO gave pyridine, isolated as its oxalate. All of the ^{14}C in I was located at C-2', as found previously. The ε- and not the α-amino group of lysine was incorporated directly into the piperidine ring of I. The results were discussed. (CA 61; 1964, 13643b)

482 Leete, E., Gros, G. E., Gilbertson, T. J. BIOSYNTHESIS OF THE PYROLLIDINE RING OF NICOTINE. FEEDING EXPERIMENTS WITH ^{15}N-LABELED ORNITHINE-2-^{14}C. Tetrahedron Lett. 11 (1964) 587-92.

Sterile root cultures of Nicotiana tabacum were fed with α- and δ-^{15}N-labelled ornithines (I) (prepared according to Maimind et al., CA 53, 2105e) by the procedures of Dawson et al. (CA 55, 5608d). Each culture flask containing 30 ml nutrient solution was fed approximately 1 mg of a mixture of DL-ornithine-2-^{14}C and ^{15}N-labelled I, and after 1 month, the roots were harvested. The nicotine (II) was isolated as the dipicrate and converted to the diperchlorate for ^{15}N assay by mass spectrometry. Oxidation of II with $KMnO_4$ yielded nicotinic acid, isolated as the Me ester. Determination of the distribution of ^{14}C in the isolated II showed an equal and unique location at the C-2 and C-5 positions of the pyrrolidine ring. The degree of incorporation of ^{14}C and ^{15}N into II was tabulated. In two experiments a high specific incorporation of ^{14}C into the pyrrolidine ring of II was found. In experiment one with feeding of a mixture of I-2-^{14}C and I-α-^{15}N, no excess ^{15}N was detected in II. In the second experiment involving I-δ-^{15}N, excess ^{15}N was detected in the pyrrolidine ring but not in the pyridine ring. The results were explained by postulation of ornithine-α-transaminase in tobacco roots and catalysis of the formation of $H_2NCH_2CH_2CH_2COCO_2H$, resulting in loss of ^{15}N from I-2-^{14}C-α-^{15}N, followed by transamination with amino acids to I-2-^{14}C containing essentially no excess ^{15}N. Decarboxylation of I to putrescine followed by oxidative deamination via 4-aminobutanol would give Δ^1-pyrroline labelled equally at C-2 and C-5. In this oxidation half of the N of putrescine was lost and accounted for the specific incorporation of twice as much ^{14}C as ^{15}N in experiment two. An alternative mechanism through transamination of I-2-^{14}C-δ-^{15}N to α-oxo-δ-aminovaleric acid was discussed. (CA 60; 1964, 14841a)

483 Liebman, A. A., Morsingh, F., Rapoport, H. BIOSYNTHESIS OF NICOTINE IN Nicotiana glutinosa FROM CARBON-14 DIOXIDE. LABELING PATTERN IN THE PYRROLIDINE RING. J. Am. chem. Soc. 87, 19 (1965) 4399-401.

A $^{14}CO_2$ biosynthesis was carried out, and the results of degradation of the aerial nicotine tabulated (Table 1). It had been previously shown by the authors that C-2' and C-5' contain essentially equal amounts of ^{14}C. The value found for C-3' in this experiment was lower by a factor of four than the value predicted by the symmetrical intermediate hypothesis. This was not due to a species difference since the pathway of exogenous ornithine from to the pyrrolidine ring of nicotine could be shown to be the same for all Nicotiana species tested. The labelling pattern of the pyrrolidine ring formed from $^{14}CO_2$ exposure must be concluded to differ markedly from that produced by precursor feeding; the labelling pattern following short-term exposure to $^{14}CO_2$ must result predominantly from an unsymmetrical intermediate.

484(2) McKennis, H., Jr., Wada, E., Bowman, E.R., Turnbull, L.B. DEMETHYLATION IN THE METABOLISM OF (−)-NICOTINE IN VIVO. Nature, Lond. 190 (1961) 910-11.

Nicotine-methyl-^{14}C was synthesized in high yield by methylating (−)-nornicotine with formaldehyde-^{14}C in the presence of formic acid. Labelled nicotine was administered intraperitoneally (0.2 mg/100 g) to male albino rat (~250 g), the approximate radioactivity of the dose being 24.8×10³ cpm. Expired CO_2 was collected. A small but significant amount of ^{14}C-activity was present as urea. The fact that previous workers did not obtain any indication that nicotine is degraded to CO_2 may be attributed to a lower level of methyl-^{14}C activity of the nicotine used by them. Since the radioactivity of randomly labelled nicotine-^{14}C is excreted (Bennett et al.: Archs int. Pharmacodyn. 98: 1954, 221) to the extent of 94% in the urine of rats, the addition of ^{14}C determined as CO_2 gives a total elimination which approaches 100%. The storage of nicotine or its metabolites after single doses occurs therefore only to an extremely limited extent.

485(1) Owen, F.B., Jr., Larson, P.S. FATE OF NICOTINE IN THE ANIMAL BODY. VIII. OBSERVATIONS ON THE NUMBER AND CHEMICAL NATURE OF NICOTINE METABOLITES IN THE DOG AND THE CAT. Archs int. Pharmacodyn. Thér. 115 (1958) 402-7.

From its absorption peak with CNBr and R_f values, 4-methylamino-4-(3-pyridyl)butyric acid is believed to be an end product of the metabolism of nicotine in the dog, although the amount excreted in this form is very small. Methylamine is probably not formed. At least three major and four minor peaks were found by paper chromatography. (CA 53: 1959, 1534i)

486 Self, L.S., Guthrie, F.E., Hodgson, E. ADAPTATION OF TOBACCO HORNWORMS TO THE INGESTION OF NICOTINE. J. Insect Physiol. 10, 6 (1964) 907-14.

Biosynthetically produced nicotine, randomly labelled with ^{14}C, was used. Larvae were offered tomato leaves treated with labelled and non-labelled nicotine (500 μg/larva). Radiometric, chromatographic, and spectrophotometric data show excretion and egestion of intact nicotine to be an explanation for the adaptation of the tobacco hornworm, Protoparce sexta (Johan.), to tobacco. There was no evidence for the metabolism of nicotine to less toxic metabolites after topical, injected, or ingested doses. Although nicotine was absorbed into the blood of the hornworm, a toxic dose did not appear to accumulate at the site of action.

487(1) Tso, T.C., Jeffrey, R.N. BIOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. I. FATE OF LABELED TOBACCO ALKALOIDS SUPPLIED TO Nicotiana PLANTS. Archs Biochem. Biophys. 80 (1959) 46-56.

The ^{15}N-labelled alkaloids, nicotine, nornicotine, and anabasine, were supplied through the roots of N. rustica var. brasilia in water culture. ^{15}N and $^{14}CH_3$ doubly labelled nicotine was supplied similarly to N. glauca to study the fate of these alkaloids in Nicotiana plants. A majority of the labelled alkaloid supplied was metabolized and the label appeared in other compounds. The major alkaloid found was characteristic of the experimental plant, and was equally labelled with ^{15}N in both rings as was the alkaloid supplied. Some of the ^{15}N alkaloids supplied probably were converted to new alkaloids by a route more direct than through the general metabolic pool. The ^{15}N:^{14}C ratio of the anabasine in N. glauca was half that of the ^{15}N, methyl-^{14}C-labelled nicotine supplied. Thus the anabasine was not formed by mere rearrangement of the nicotine molecule. (CA 53: 1959, 11537g)

488(2) Tso, T.C., Jeffrey, R.N., Sorokin, T.P. BIOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. II. THE RELATIVE ABSORPTION AND ASSIMILATION OF C^{14} FROM $C^{14}O_2$ GAS AND FROM $NaHC^{14}O_3$ SOLUTION. Archs Biochem. Biophys. 92 (1961) 241-7.

Nicotiana plants were exposed in the presence of light to various amounts of $^{14}CO_2$ for different lengths of time and under different experimental conditions. After 1 h of exposure, ^{14}C activity was found in sugars, organic acids, pigments, and amino acids, in order of decreasing activity. If the exposed plant was allowed to grow a few more days in the greenhouse, ^{14}C was incorporated gradually into the alkaloids. When $NaH^{14}CO_3$ was supplied from solution to the roots of N. rustica, ^{14}C activity was also found in pigments, amino acids, organic acids, and sugars, but almost no activity was found in alkaloids after exposure to 500 μCi of ^{14}C within 9 d. When a similar plant was grown in $NaH^{14}CO_3$ solution 124 h within 9 d and then in nutrient solution for 7 more d before analysis, ^{14}C activity gradually appeared in alkaloids. The total recovery of ^{14}C supplied to the roots from $NaH^{14}CO_3$ was only 1.6-1.75%, whereas 7.5-13.7% of that supplied to the leaf as $^{14}CO_2$ was recovered. (From CA 55: 1961, 1355a)

489(2) Tso, T.C. BIOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. III. THE INCORPORATION OF C^{14} AND N^{15} IN ALKALOID BIOSYNTHESIS. Archs Biochem. Biophys. 92 (1961) 248-52.

Incorporation of ^{14}C and ^{15}N by alkaloid biosynthesis into three species of Nicotiana: N. glauca, N. glutinosa, and N. rustica, in which anabasine, nornicotine, and nicotine, respectively, are the principal alkaloids, was studied. The source of ^{14}C was $^{14}CO_2$ by photosynthesis or $NaH^{14}CO_3$ in water solution, while ^{15}N was supplied in nutrient solution as $K^{15}NO_3$. ^{14}C was incorporated into the alkaloids rather slowly. No activity was found in the alkaloids from plants sampled 90 min after initial exposure to $^{14}CO_2$. As $^{14}CO_2$-exposed plants grew, ^{14}C was incorporated into the alkaloids, but a gradual loss of total ^{14}C from the plant took place. $NaH^{14}CO_3$ was a poorer source of ^{14}C from the viewpoints of alkaloid biosynthesis and of total ^{14}C recovery than $^{14}CO_2$. The incorporation of ^{15}N into alkaloids was selective. In N. glauca, anabasine had the highest ^{15}N excess. In N. rustica, nicotine had the highest ^{15}N excess. In N. glutinosa, nornicotine had the highest ^{15}N excess when ^{15}N was supplied starting from early stage of plant growth, while nicotine had the highest ^{15}N excess when ^{15}N was supplied only at a late stage of plant growth. Nicotine had the highest specific ^{14}C activity of the alkaloids in the experimental plants, despite the fact that the principal alkaloids of these species are different. The relative incorporation of ^{14}C and ^{15}N into alkaloids seems to indicate that the ^{14}C and ^{15}N of different alkaloids come from different pathways or precursors. (From Auth. summary)

490(2) Tso, T.C., Jeffrey, R.N. BIOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. IV. THE DYNAMIC STATE OF NICOTINE SUPPLIED TO N. rustica. Archs Biochem. Biophys. 92 (1961) 253-6.

Nicotine doubly labelled with ^{14}C and ^{15}N was supplied at intervals to Nicotiana rustica var. brasilia by placing the roots in a nicotine solution. The plant was supplied with complete nutrient solutions between exposures. Of the original ^{14}C activity, 34.4% was recovered and the remainder was presumably lost by respiration. The ^{14}C activity of the groups of compounds recovered from the plant decreased in the following order: alkaloids, free amino acids, pigments, furfural after hydrolysis, amino acids after hydrolysis, sugars after hydrolysis, free organic acids, free sugars, insoluble residue, and organic acids after hydrolysis. Of the original ^{15}N excess, 91.6% was recovered. The amount of ^{15}N excess found in the plant was greatest in the insoluble residue after hydrolysis followed by the amino acids after hydrolysis, free alkaloids, free amino acids, and pigments. Much of the nicotine appears to have entered the plant as such and some remained unaltered. A larger proportion was metabolized, and the resulting C and N residues entered the general metabolism of the plant and appeared in all classes of compounds separated. These results indicate that nicotine supplied as in this experiment takes active part in the metabolism of a Nicotiana plant. (CA 55: 1961, 13555g)

491(2) Tso, T.C., Jeffrey, R.N. BIOCHEMICAL STUDIES ON TOBACCO ALKALOIDS. V. THE INCORPORATION OF ^{3}H IN ALKALOID BIOSYNTHESIS. Archs Biochem. Biophys. 97 (1962) 4-8.

The incorporation of ^{3}H in alkaloid biosynthesis was studied by growing Nicotiana rustica var. brasilia plants in tritiated water. The rate of ^{3}H incorporation was very fast in the first 2.5 h, after which it was much slower for the remainder of the 70 h experiment. The relative rate of incorporation of ^{3}H in different classes of organic compounds was similar to that of ^{14}C from $^{14}CO_2$, except that incorporation of ^{3}H into the alkaloids was much more rapid. ^{3}H activity was detected in tobacco alkaloids 30 min after a 1 min exposure, whereas ^{14}C incorporation into the alkaloids was not detected in 30 min after a 60 min exposure. The relative changes of the ^{3}H specific activities of different alkaloids obtained from plants exposed for different lengths of time to tritiated water can best be explained by considering nornicotine to be a precursor of nicotine under the experimental conditions. (CA 57: 1962, 2600h)

492 Yang, K.S., Gholson, R.K., Waller, G.R. STUDIES OF NICOTINE BIOSYNTHESIS.* J. Am. chem. Soc. 87, 18 (1965) 4184-8.

Quinolinic acid was found to be an efficient precursor of nicotine in whole tobacco plants (Nicotiana tabacum L.). A method for the stepwise degradation of the pyridine ring of nicotine is described which involves the oxidation of nicotine to nicotinic acid, the biological conversion of nicotinic acid to ricinine, and the chemical degradation of ricinine. Using this degradation method it could be shown that glycerol is incorporated without randomization into carbons 4, 5, and 6 of the pyridine ring of nicotine. This degradation method was also used to confirm the mechanism of fusion of the pyridine ring of nicotinic acid with the pyrrolidine ring during nicotine biosynthesis, previously proposed by Dawson, et al. (J. Am. chem. Soc. 82 ; 1960, 2629-33, II/690) The following labelled substances were used in syntheses of nicotine: quinolinic acid-2,3,7,8-^{14}C, nicotinic acid-2,3,7-^{14}C, glycerol-1-^{14}C and glycerol-2-^{14}C, and quinolinic acid-^{3}H.

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* A preliminary report of a portion of this work has been presented: see Gholson, R.K., Chandler, J.L.R., Yang, K.S., and Waller, G.R. in Fedn Proc. Fedn Am. Socs exp. Biol. 23: 1964, 528.

See also:

263 Adaptation of insects to tobacco. (Self, L.S., 1965)

8. Rotenoids

493 Fukami, J., Casida, J.E. METABOLISM OF ROTENONE-6a-C^{14} BY RAT LIVER ENZYMES. Bull. ent. Soc. Am. 11, 3 (1965) 156. Abstr. 40. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Four major and five minor ether-extractable rotenone-6a-^{14}C metabolites are formed by the microsome-NADPH$_2$ system. Addition of the liver soluble fraction yields metabolites extractable with butanol but not ether. Rotenolone 1 may be the initial product in one metabolic pathway. Dehydrorotenone-6a-^{14}C yields completely different metabolites than those derived from rotenone-6a-^{14}C. (Abstr.)

494 Nishizawa, Y., Casida, J.E. SYNTHESIS OF ROTENONE-6a-^{14}C ON A SEMIMICRO SCALE. J. agric. Fd Chem. 13, 6 (1965) 522-24.

Reaction of a 2 mM of methyl bromoacetate-1-^{14}C with 3 mM of derritol produced 6a, 12a-dehydrorotenone-6a-^{14}C in approximately 50% yield. Sodium boron hydride reduction gave the 12-hydroxy-6a-^{14}C intermediate and subsequent Oppenauer oxidation produced rotenone-6a-^{14}C. Yields for conversion of non-radioactive 6a, 12a-dehydrorotenone to rotenone were 17-25% but, with radioactive material of 2.36 mCi/mM, the yield was only 7.5%. Other oxidation procedures for the reduction product of 6a, 12a-dehydrorotenone are considered, as are possible explanations for the lower yield with the radioactive material. (Auth.)

9. Chemosterilants

495 Chamberlain, W.F., Hamilton, E.W. ABSORPTION, EXCRETION, AND METABOLISM OF ^{32}P-LABELED METEPA BY SCREW-WORM AND STABLE FLIES. J. econ. Ent. 57, 6 (1964) 800-3.

The rate of absorption, excretion, and metabolism of ^{32}P-labelled metepa (specific activity 12 614 cpm/μg) by the screw-worm fly, Cochliomyia hominivorax (Coquerel), and the stable fly, Stomoxys calcitrans (L.), explain to a considerable extent the difference noted between the dosages required to sterilize these two species. On the basis of data obtained 6 h after treatment, the screw-worm fly absorbed only half as much radiolabelled material in proportion to its size as the stable fly. Excretion by the screw-worm fly was twice that of the stable fly, and metabolism by the stable fly was about twice as fast as for the screw-worm fly. The principal metabolite was phosphoric acid, and it occurred in greater quantity in the screw-worm fly than in the stable fly. (Essentially auth.)

496 Chang, Shen Chin, METABOLISM OF C^{14} LABELED TEPA BY HOUSE FLIES. Bull. ent. Soc. Am. 11, 3 (1965) 156. Abstr. 41. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. -2 Dec. 1965".

Tepa-^{14}C (uniformly labelled) with a specific activity of 12 mCi/mM was used in the metabolic study. The results from the radiometric, colorimetric and biological study will be discussed. (Abstr.)

497(1) Craig, A.W., Jackson, H. THE METABOLISM OF ^{32}P-LABELLED TRIETHYLENEPHOSPHORAMIDE IN RELATION TO ITS ANTI-TUMOUR ACTIVITY. Br. J. Pharmac. Chemother. 10, 3 (1955) 321-5.

Triethylenephosphoramide (TEPA) containing ^{32}P was prepared (CA 44, 5805i) chromatographically pure. No specific localization of ^{32}P in rat tissues occurred after doses which effectively inhibited Walker carcinosarcoma and Jensen sarcoma. In tumour tissue the activity was distributed between the Cl_3CCO_2H-soluble material (32%), lipides (23%), nucleic acids (25%), and proteins (20%). Of the injected dose 80% was excreted in the urine in 24 h, the majority as TEPA. The only detected metabolite was inorganic P. Cytotoxic activity of TEPA may be due to interference by a small proportion of the dose administered with a highly susceptible cellular mechanism. (CA 50: 1956, 2067g)

498 Dame, D.A., Schmidt, C.H. UPTAKE OF METEPA AND ITS EFFECT ON TWO SPECIES OF MOSQUITOES (Anopheles quadrimaculatus, Aedes aegypti) AND HOUSE FLIES (Musca domestica). J. econ. Ent. 57, 1 (1964) 77-81.

^{32}P-labelled metepa was rapidly absorbed from glass surfaces by both mosquitoes (A. quadrimaculatus Say and A. aegypti (L.)) and house flies (M. domestica L.). House flies and quadrimaculatus absorbed approximately 7 μg per insect during a 4 h exposure on surfaces treated at 10 mg/ft^2 whereas aegypti picked up 2.5 μg. This uptake resulted in a severe reduction of mating ability in mosquitoes, coupled with 99% sterility in house fly and aegypti males. Metepa was found to be quite volatile on glass surfaces and highly sorptive on masonite. Under similar conditions quadrimaculatus absorbed 27 mμg from masonite treated at 100 mg/ft^2 and 7600 mμg from glass treated at 10 mg/ft^2. After 3 d of feeding on treated food, the amounts of the chemosterilant absorbed, expressed in μg-equivalents of ^{32}P metepa, were 3.0, 3.7, 1.7 in quadrimaculatus, house flies, and aegypti, respectively. These dosages caused sterility in all species without reducing male vigor. Exposure of mosquito larvae from the 3rd instar through pupation in water treated at 10 ppm resulted in low metepa uptake and very little induced sterility. The distribution of metepa in the insects was rapid and apparently non-selective. Excretion was rapid in insects exposed to residual deposits of 10 mg/ft^2. Insects exposed to treated larval medium and food retained a high percentage of their original radioactivity over prolonged periods; this activity undoubtedly represented detoxified metepa, however. (Auth.)

499 Painter, R.R., Kilgore, W.W. CHEMOSTERILANT EFFECT OF 5-FLUOROOROTIC ACID ON HOUSE FLIES. J. econ. Ent. 58, 5 (1965) 888-91.

When fed to adult house flies, Musca domestica L., at a level of 1.0% for 48 h after emergence, 5-fluoroorotic acid was found to be a permanent sterilant, eliminating oviposition. Although oviposition was greatly reduced at lower concentrations, a significant percentage of the eggs hatched and normal-appearing second generation flies were reared. Five-fluoroorotic acid-2-^{14}C was incorporated into the ovaries for 48 h after removal of the chemical from the diet. But the testes did not at any time contain a significant quantity of the labelled 5-fluoroorotic acid. (Auth.)

500 Parish, J.C., Arthur, B.W. MAMMALIAN AND INSECT METABOLISM OF THE CHEMOSTERILANT THIOTEPA. J. econ. Ent. 58, 5 (1965) 976-9.

Thiotepa, tris (1-aziridinyl) phosphine sulphide, was synthesized with a ^{32}P label and its metabolic fate was studied in white rats and four species of insects. Thiotepa was administered topically at 100 mg/kg to the German cockroach, Blattella germanica (L); house fly, Musca domestica L.; stable fly, Stomoxys calcitrans (L.); and boll weevil, Anthonomus grandis Boheman, and orally to white rats at 10 mg/kg or dermally at 25 mg/kg. The amount of thiotepa absorbed at 0, 1, 4, and 24 h after treatment by different species of insects was determined. Maximum absorption had occurred by 4 h after treatment for all insects except the boll weevil. Tepa, the oxygen analogue of thiotepa, was the only chloroform-soluble metabolite of thiotepa recovered from insects. In German cockroaches, house flies, and stable flies the amount of thiotepa decreased with time after treatment; the opposite was true for boll weevils. During the 5-d experimental period, 24.3% of the administered thiotepa was eliminated in the urine of orally treated rats and 27.4% was eliminated in the urine of dermally treated rats. The orally and dermally treated rats eliminated 17.2 and 34.7% in the faeces, respectively. From 54-91% of the ^{32}P-materials eliminated in the urine and faeces of rats were hydrolytic products. Chloroform-soluble ^{32}P-materials recovered from the urine were 90% tepa from orally treated rats and about 50% tepa from dermally treated rats. Tepa was also the predominant product recovered in the chloroform extracts of faeces from orally or dermally treated rats. Three water-soluble products were isolated from the urine of rats, but were not identified. The liver and kidney contained higher concentrations of radioactive materials than fat, leg muscle, brain, reproductive organs, or blood. (Auth.)

See also:

155 Incorporation of glycine-2-14 into untreated and chemosterilant treated house flies. (Painter, R.R., Kilgore, W.W., 1965)

10. Synergists

501 Kuwatsuka, S., Casida, J.E. SYNTHESIS OF METHYLENE-C^{14}-DIOXYPHENYL COMPOUNDS: RADIOACTIVE SAFROLE, DIHYDROSAFROLE, MYRISTICIN, PIPERONYL BUTOXIDE, AND DIASTEREOISOMERS OF SULFOXIDE. J. agric. Fd Chem. 13, 6 (1965) 528-33.

Methylene-^{14}C iodide, prepared by reduction of iodoform-^{14}C was made to react with the appropriate catechol to yield the following methylene-^{14}C-dioxyphenyl compounds with a specific activity of 1.0 mCi/mM: safrole, dihydrosafrole, myristicin, sulphoxide synergist {1,2-methylenedioxy-4-[2-(octylsulphinyl)propyl]benzene}, and piperonyl butoxide { -[2-(2-butoxyethoxy)ethoxy]-4,5-methylenedioxy-2-propyltoluene}. Yields from iodoform-^{14}C were 31 to 55% on a 0.5- to 0.8-mM scale except with piperonyl butoxide, where the yield appeared to be related to the specific activity of the methylene-^{14}C iodide used. The octylthio, octylsulphinyl, and octylsulphonyl analogues of sulphoxide synergist, substituted on the 1-, 2-, or 3-position of the propyl group, were prepared in non-radioactive form for comparative purposes. Sulphoxide synergist and the 1-octylsulphinyl analogue were resolved by chromatography into the enantiomorphs of the diastereoisomers about the sulphoxide grouping and the asymmetric carbon of the propyl grouping. The potency as synergists for the insecticidal activity of carbaryl (1-naphthyl methylcarbamate) and pyrethrum with houseflies (Musca domestica L.) was compared for all the non-radioactive methylenedioxyphenyl compounds prepared. (Auth.)

502 Pereira, J.F., Yamaguchi, S. ABSORPTION AND TRANSLOCATION OF ARSENATE ARSENIC BY COFFEE PLANTS. Turrialba 14, 2 (1964) 91-93. (In Spanish, with English summary)

Coffee plants (Coffea arabica L.) were treated with ammonium arsenate (^{77}As) and arsenic metabolism studied autoradiographically. No translocation occurred except in young leaves; marked absorption was observed in roots and in leaves.

503 Young, S.Y., Berger, R.S. THE METABOLISM OF S^{35} LABELED BAYER 9017. Bull. ent. Soc. Am. 11, 3 (1965) 157. Abstr. 44. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

The metabolism of ^{35}S-labelled Bayer 9017, an experimental animal systemic, was studied in dairy calves. One calf was treated orally and another dermally, then held for 24 h. Blood, urine, and faecal samples were taken. The animals were then sacrificed, tissue samples taken and Bayer 9017 and metabolites were determined. (Abstr.)

See also:

84 The effect of malathion on the metabolism of amino acids in the German cockroach Blattella germanica. (Mansingh, A., 1965)
155 Incorporation of glycine-2-C-14 into untreated and chemosterilant treated house flies. (Painter, R.R., Kilgore, W.W., 1965)
263 Adaption of insects to tobacco. (Self, L.S., 1965)
329 Methylenedioxyphenyl compounds as inhibitors of the hydroxylation of naphtalene in houseflies. (Philleo, W.W. et al., 1965)
363 Absorption and distribution of DDT in the boll weevil and the influence of synergists on toxicity. (Land, J.D., 1963/64)
468 Metabolism in vivo of ^{14}C-labelled pyrethrin I and cinerin I by house flies with special reference to the synergistic mechanism. (Chang, S.C., Kearns, C.W., 1964)

11. Repellents

See

402 Carbamate insecticides: synergism by organothiocyanates. (El-Sebay, A.H. et al, 1964)
1046 Procedure for bioassaying mosquito repellents in laboratory animals. (Lal, H. et al., 1963)

II

IONIZING RADIATIONS

A. CELLULAR AND GENETIC EFFECTS

1. General Articles. Surveys. Books. Progress Reports (Several Topics)

504 Atomic Energy of Canada Ltd., Chalk River (Ontario). ACTIVITIES OF AECL IN THE FIELDS OF BIOLOGY, HEALTH PHYSICS AND MEDICINE. AECL-2107. Nov. 1964, 34p.

Activities in the fields of biology, health physics, and medicine are summarized. Results are also reported from studies on the effects of γ-dose rate on the number of radio-induced mutations in the small wasp *Dahlbominus*; the detection of electrical potentials in cockroach eyes following stimulation by x-radiation; and the effects of x-radiation on metabolism in the giant mitochondria involved in energy supply to wing muscles of the house fly.

505 National Inst. of Radiological Sciences, Chiba (Japan). BIOLOGICAL STUDIES. p. 50-56 of "Annual Report, 1963". NIRS-3. Dec. 1964, 93p.

Genetic research included work on the effects of chronic irradiation on sex-linked lethal mutation frequencies in *Drosophila*; comparison of frequency patterns between whole-body and fractional mutations; modification of x-ray induced visible mutation frequencies by chromosome structure; effects of nitrogen on mutation rates in x-irradiated germ cells; effects of penicillin feeding on reduction of radioinduced mutation rates; effects of temperature and genetic background on the pre-adult viability of lethal heterozygotes; and genetic effects of x-rays on the quantitative characters in a heterozygous population.

506(2) Kitzmiller, J.B. MOSQUITO CYTOGENETICS. A Review of the Literature, 1953-62. *Bull. Wld Hlth Org.* *29*, 3 (1963) 345-55.

Available information is still superficial and limited to a few mosquito species. The author reviews and summarizes research in the field. Sexual differences in the salivary X-chromosomes have been reported for several species of *Anopheles*. Chromosomal polymorphism is common in some anophelines, but rare in others. Chromosomal mutation has been induced by means of x-rays. In his conclusion the author stresses that prospects are especially good for evolutionary and genetic studies involving chromosomal polymorphism.

507 Kondo, S. VARIATION IN MUTAGENICITY AND RADIATION RESISTANCE WITH GENOME COMPLEXITY AND EVOLUTION. *Idengaku Zasshi* (Jap. J. Genet.) *39*, 2-3 (1964) 176-98.

After summarizing the mutagenic studies on higher and lower organisms carried out by the group the author discusses the RBE for mutations, comparing it with the RBE for somatic damage. The apparent RBE for mutagenicity reflects not only the efficiency of premutation induction, but also the depression of repair mechanisms. It is concluded that mutagenic factors are also involved differing with genome complexity. The increase in resistance to radiation-induced DNA damage with genome complexity is more noticeable with u.v. than with ^{32}P or x-rays. Based on the evolutionary point of view, a repair-tolerance model is proposed for mutagenesis to account for the differential factors in mutagenesis, which reflect differences in the mechanisms of repairing and tolerating premutational DNA damages among different organisms. Work on *Drosophila* and silkworm is cited.

508 Lewontin, R. A STUDY OF MATHEMATICAL MODELS OF MUTATION AND SELECTION IN MULTILOCUS SYSTEM. Annual Progress Report, September 1, 1963-August 31, 1964. TID-20714, Rochester, N.Y. Univ. 15 June 1964, 9p.

Progress is reported in genetic studies in *Drosophila* populations. A computer programme was developed for use in studies on the influence of linkage on changes in gene and gamete frequency in a hypothetical population of *Drosophila* consisting of 500 males and 500 females, each with

30 loci, mating at random with discrete generations. Data are also included from studies on 5-locus models, the effects of isolation by distance on populations of finite size, studies on auto-incompatibility, selection of polygenic characters, selection of components of fitness, and the intrinsic rates of increase in Drosophila populations. (NSA18:1964, 27018)

509(2) National Inst. of Genetics, Misima (Japan). RADIATION GENETICS IN ANIMALS. p. 93-116 of "Annual Report of the National Institute of Genetics, No. 14, 1963". NP-14037, 1964.

Results are included from studies on radioinduced mutations in Drosophila melanogaster and silkworms.

510 Rico, M. GENETIC BASIS OF RESISTANCE TO RADIATION. Spain. Inst. Nac. Invest. Agron. B. 24, 50 (1964) 97-101. (In Spanish, with English summary)

Work on Drosophila melanogaster is discussed.

511 Rochester Univ., N. Y. Atomic Energy Project. RADIATION EFFECTS - GENERAL. p. 1-54 of "University of Rochester, Atomic Energy Project. Brief Description of Most of the Research Programs Completed during 1964". UR-668. 1 Jan. 1965, 175p.

Some mention is made of the effects of x-irradiation on Drosophila spermatozoa.

2. Nuclear and Cytoplasmic Biochemistry, Physiology, and Ultrastructure

512 Bartlett, A. C., Bell, A. E. GENE NUMBER, EFFECT, AND MUTATION RATE FOR BODY WEIGHT IN Tribolium castaneum. TID-20082, Purdue Univ., Lafayette, Ind. nd, 7p.

x-radiation was used in a study of selection. Body weight in T. castaneum was estimated to be controlled by 607 pairs of genes. Each gene locus was estimated to have an average phenotypic effect of 0.0046 mg. The radiation-induced mutation rate of these quantitative genes was of the magnitude of 10^{-4} and 10^{-5} mutations/R/gene locus. (From auth.)

513 Buchholtz, Ch. ELECTRON MICROSCOPIC FINDINGS IN THE IRRADIATED SUPRAESOPHAGEAL GANGLION OF ODONATA LARVAE (Calopteryx splendens Haar). Z. Zellforsch. 63, (1964) 1-24. (In German)

Four types of neurons were observed in the supraesophageal ganglia of Odonata larvae x-irradiated with 100 000 R during the Y and Z developmental stages. These were globular perikaryon, large perikaryon with large round nuclei, large cytoplasm-rich perikaryon with nuclei, and perikaryon with neurosecretory activity. Changes in all except the second type induced by irradiation included increased volume of neuroplasm and reduced size of nuclei. The nucleolus was visible in the karyoplasm of the large round nuclei. High concentrations of chromatin were visible in all four types of perikarya after irradiation. Differences between the perikarya were shown in the endoplasmatic reticulum containing ribosomes, the dictyosomes, and the mitochondria. Very dark granules that suggested ribosomes concentrations were observed particularly in the perikarya with large round nuclei. The secretory vacuoles of the neurosecretory perikarya were reduced and clumped together because of loss of their membranes. Studies with the light microscope indicated increases in cell volume and nuclear swelling after irradiation with 40 000 to 50 000 R. Usually these changes were reversible, but after 50 000 to 150 000 R there were irreversible changes. These included localization and accumulation of tigroid material, with appearance of chromatin in the nucleus that shifted the nucleolus to the nuclear edge. Following this the nucleus shifted to the periphery of the cytoplasm, while the tigroid substance separated into five particles and finally disappeared. During this phase there was partial vacuolization of the cytoplasm. Complete necrosis was indicated by appearance of completely pyknotic residual bodies. (NSA19:1965, 43849)

514 Alexander, M. L., McKinley, K. CYTOLOGICAL DAMAGE ASSOCIATED WITH GENETIC MUTATIONS IN Drosophila WITH BETATRON TREATMENT. Radiat. Res. 22, 1 (1964) 166. Abstr. 4.

Treatment of premeiotic spermatogonia of Drosophila with 22 MeV betatron x-rays resulted in higher percentages of dominant lethals than 250 kVp therapy x-rays although the latter produced more dominant lethals in postmeiotic cells. Disproportionate amounts of chromosome breakage with the two radiations were tested for correlation with the possible elimination of injured cells by cellular degeneration. With therapy x-ray greater numbers of cells may degenerate at meiotic divisions and fewer genetic dominant lethals be recovered in postmeiotic stages than with betatron. Genetic and cytological damage were tested with betatron for comparison to previous therapy x-ray tests. Mature sperm of D. melanogaster were treated with 3000 rad of betatron x-rays and genetic mutations checked at eight specific gene loci, ru h th st p^p cu sr e^s in the third chromosome. Sixty-one mutations were observed in 50 242 individuals to give an average mutation rate of 5.06×10^{-8} per rad/locus. Fifty-one of the induced mutations were tested for viability and 19 were homozygous viable and 32 lethal. In the cytological analyses, there have been no chromosome aberrations observed among viable mutations; among lethals, eight showed no chromosome aberrations, eleven contained deletions and one an inversion. Comparisons to results for therapy x-ray show that the mutation rates are similar. The proportion of viable and recessive lethal mutations is similar, but there appears to be an almost complete absence of translocations and inversions. The data indicate that chromosome breakage occurs equally frequently with both radiations but that the recovered breakage has a different distribution. (Abstr.)

515 Hess, O. THE EFFECT OF x-RAYS ON THE FUNCTIONAL STRUCTURES OF THE Y CHROMOSOME IN SPERMATOCYTES OF Drosophila hydei. J. Cell Biol. 25, 1, Pt. 1 of 2 (1965) 169-73.

At least five sites of the Y-chromosome of D. hydei form loops of specific morphology which seem to occur in correlation with a phase of activation of certain genes in spermatocyte nuclei. x-irradiation in doses of as low as 1 000 R causes characteristic morphological alterations of the loops. Exactly the same alterations have been observed earlier after treatment with actinomycin. The alterations are reversible. As expected, and unlike actinomycin, x-irradiation causes also some irreversible damage; i. e. complete or partial suppression of loop regeneration, as well as breaks within the loops. The results are not inconsistent with the suggestion that in Drosophila spermatocytes the DNA-directed synthesis of RNA can be reversibly inhibited by x-irradiation. (Auth.)

516 Hildreth, P. E. FERTILIZATION IN Drosophila. II. TIME OF INACTIVATION OF GENE EFFECT. p. 133-44 of "Biology and Medicine Semiannual Report, Spring 1965". UCRL-16246, California Univ., Berkeley. Donner Lab. and California Univ., Berkeley. Donner Pavilion. nd, 190p.

For abstract, see 517.

517 Hildreth, P. E. FERTILIZATION IN Drosophila. II. TIME OF INACTIVATION OF GENE EFFECT. Proc. natn. Acad. Sci. U. S. A. 54 (1965) 736-41.

Previous experimenters found an inactivation effect of a suppressor gene in D. melanogaster when eggs in early stages after fertilization were irradiated. A repetition of these experiments with presently available stocks did not confirm the original findings. The data do not support the view that the gene action of Su-er is determined very early, or the alternative view that a substance upon which the gene Su-er acts is inactivated by x-rays after fertilization of the egg but before cleavage divisions have begun. (Auth.)

518(2) Ito, T., Tanaka, M. EFFECTS OF γ-IRRADIATION ON THE ACTIVITIES OF DIGESTIVE ENZYMES OF THE SILK WORM. Nippon Sanshigaku Zasshi (J. seric. Sci., Tokyo) 32 (1963) 330-37. (In Japanese)

When newly moulted 5th-instar larvae of Bombyx mori were irradiated with ^{60}Co γ-rays at dosages of 60 or 80 kR, invertase, β-glucosidase, and trehalase of the midgut as well as amylase and proteinase of the digestive juice were inhibited. The radiosensitivity varied according to the enzyme. With Me_2CO-dried midgut and lyophilized digestive juice, the rate of inhibition was highly related not only to the dosage of γ-rays but also to the concentration of enzyme. (CA 63:1965, 4624e)

519(2) Lezzi, M. DAS VERHALTEN DES PUFFMUSTERS DER SPEICHELDRÜSEN-CHROMOSOMEN VON Chironomus UNDER DEM EINFLUSS VON Drosophila-EIINHALT. (Behaviour of the puff pattern of the salivary-gland chromosomes in Chironomus under the influence of Drosophila egg contents). Diplomarbeit. Eidgenössische Technische Hochschule, Zurich (Switzerland). 1961, 30p. (In German)

The behaviour of the puff pattern of C. thummi was examined under various conditions with special reference to both ends of the third and the right end of the second chromosome. In normal development, four stages with characteristic puff pattern can be distinguished: young larvae (beginning of 4th larval instar), older larvae (during the 4th instar), pre-pupae, and "red" pupae (immediately after pupal moulting). Rejuvenation of the puff pattern occurred under several conditions: in explants of glands in haemolymph or Ringer solution, and in larvae ligated in the regions of the glands. Rejuvenation was also brought about by x-rays when it proceeded in the partial absence of cytoplasm. In these experiments, larvae were exposed to 2000 R (at 1000 R/min) in the region of the gland. Rejuvenation further occurred on transplantation of salivary gland nuclei with a cytoplasmic sheath to Drosophila egg. The addition of pupal haemolymph to gland explant results in puff formation of the pupal stage; it cannot stop rejuvenation. The phenomenon of rejuvenation of the puff pattern is discussed with reference to energy supplies. Drosophila egg has proved a favourable medium for culturing nuclei.

520 McGrath, R. A., Leach, W. M., Carlson, J. G. CELL STAGES REFRACTORY TO THYMIDINE INCORPORATION INDUCED BY X-RAYS. Expl Cell Res. 37, 1 (1965) 39-44.

Embryos of the grasshopper Chortophaga viridifasciata (De Geer) were used. Autoradiographic studies of hanging-drop preparations showed that grasshopper neuroblasts, trapped in mid-mitotic stages by colchicine and then exposed to x-rays (64 R - 75 000 R) did not incorporate ^{3}H-thymidine or its derivatives into DNA. The intracellular pool of thymidine derivatives is not detectably changed by exposure to x-rays. The data show a correlation between radiation-induced incorporation of ^{3}H-thymidine derivatives and cell stage at the time of irradiation. It is suggested that the synthesis-like condition, during which x-ray-induced incorporation of DNA precursors can occur, degenerates gradually after cells stop normal synthesis of DNA.

521 Oak Ridge National Lab., Tenn. RADIATION IMMUNOLOGY. p. 112-8 of "Biology Division Semiannual Progress Report for the Period Ending February 15, 1965". ORNL-3768. May 1965, 205p.

Progress is reported on a number of studies including work on the immunology of grasshopper neuroblasts.

522(2) Pavan, C., Basile, R. EFFECTS OF RADIATION ON THE SYNTHESIS OF NUCLEIC ACIDS IN POLYTENE CHROMOSOMES. Natn. Cancer Inst. Monogr. 14 (1963) 199-204.

Experiments were done using larvae of Rhynchosciara angelae (Diptera, Sciaridae) to study the effect of ionizing radiation on the synthesis of deoxyribonucleic acid (DNA). Different groups of larvae were exposed to 1250, 2500, 10 000, and 20 000 R from a source of γ-rays, and the effect of radiation on these chromosomes was analysed. Autoradiography and ^{3}H-thymidine were used as radioactive precursor to DNA. In cells of the salivary gland of R. angelae the radiation (even the 20 000 R dose) seemed to stimulate the synthesis of DNA, as shown by the many cells incorporating ^{3}H-thymidine and also by the higher intensity of incorporation in chromosomes that received radiation as compared to non-irradiated controls. (NSA 19;1965, 8889)

523 Deleted

524 Yanders, A. F. BASIC FERTILIZATION PHENOMENA AND GAMETIC LETHALITY IN Drosophila. p. 136 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

See also:

527 The effect of x-irradiation on spermatogenesis in Drosophila melanogaster Meigen. (Abro, A., 1964)
596 A study of gene and chromosome changes induced by ionizing radiations in Drosophila melanogaster. (Godfrey, R. K., 1964)
673 Evaluation of repair processes in x-irradiated flour beetles by means of the split-dose technique. (Ducoff, H. S., Bosma, G. C., 1964)
754 Phase cinematography studies on the effects of radiation and of some chemicals on cells and chromosomes. (Nakanishi, Y. H., Makino, S., 1964)

792 The effects of ionizing radiation on the sarcosomes of housefly flight muscle. (Carney, G. C., 1965)
793 Swelling and shrinkage properties of housefly sarcosomes after in vivo exposure to x-rays. (Carney, G. C., 1965)
801 Cytological effects of radiation on testes of the screw-worm fly, Cochliomyia hominivorax. (Riemann, J. G., 1964)
838 Irradiation effects on spermatogenesis in the gipsy moth, Porthetria dispar (L.). (Rule, H. D. et al., 1965)

3. Meiotic and Mitotic Sensitivity

525 Abeleva, E. A. ANALYSIS OF THE CAUSE OF THE ANOMALOUS DEPENDENCE OF THE MUTATION FREQUENCY IN Drosophila SPERMATIDS ON THE IONIZING RADIATION DOSE. Radiobiologiya 4 (1964) 569-74. (In Russian)

Previous studies on the anomalous dependence of mutations on the radiation dose did not clarify the reason for the reduced efficiency of high-level doses. This problem was further investigated by assuming a differential radiation sensitivity of the cells at various stages of the spermatogenesis; the mutation and fertility curves of Drosophila males were compared after exposure to 1 and 3 kR of γ-radiation. It was found that the dose of 1 kR does not cause deviation from the expected linear correlation but the relative biological efficiency of the higher dose was considerably reduced. Experiments with crossing-over, carried out with the Yellow Miller strain of D. melanogaster, revealed that up to the 8th d after irradiation the male gametes produced a haploid chromosome set, thus indicating that the spermatogenesis occurred from the 4th-7th day after irradiation. On the 8th day meiotic division takes place; the 9th day is probably the period of growth of the later spermatogonia before the start of the meiosis. The mutability of the mature sperm, 1-3 d after irradiation, and of the growing spermatogonia at 1 kR were identical. The distribution of the mutability at the two dose levels agreed with the corresponding fertility curves. The data support the previously expressed assumption that the reduced relative biological efficiency of the high doses and the shift in the mutability of the spermatids are due to the death of the most genetically sensitive cells. (NSA18;1964, 41183)

526 Abrahamson, S., Friedman, L. D. x-RAY INDUCED MUTATIONS IN SPERMATOGONIAL CELLS OF Drosophila AND THEIR DOSE-FREQUENCY RELATIONSHIP. Genetics 49 (1964) 357-61.

Spermatogonial x-ray induced mutation rates were determined in adult Drosophila males. The mutation frequency was found to be proportional to dose for doses of 3000-12 000 R. (Auth. summary)

527 Abro, A. THE EFFECT OF x-IRRADIATION ON SPERMATOGENESIS IN Drosophila melanogaster Meigen. Årbok Univ. Bergen, Matematisk-naturvitenskapelig serie 10 (1964) 1-121

The time of puparium formation in D. melanogaster is prolonged when 3rd-instar larvae are exposed to x-rays. The prolongation increases with increasing doses. Development of testis and spermatogenesis seem to proceed independently of the changes that accompany the metamorphosis. Secondary spermatogonia about to differentiate into spermatocytes are most sensitive to x-rays, followed by spermatocytes initiating the meiotic divisions. Low doses sometimes produce bizarre alterations in cell morphology. Supernumery organelles occur frequently. (Auth.)

528 Alexander, M. L., Bergendahl, J. DOSE RATE EFFECTS IN THE DEVELOPING GERM CELLS OF MALE Drosophila. Genetics 49 (1964) 1-16.

The developing germ cells of D. melanogaster were treated with fast and fractionated doses of x-rays in 4 atm of Ar or in 3 atm of Ar + 2 atm O_2. An enhancement in biological damage was noted in all post-meiotic sperm and spermatid cells in tests when O_2 was present in combination with Ar. The rate at which radiation was administered did not affect mature sperm cells. Enhanced translocations and sex-linked recessive lethals were obtained for spermatids in Ar by giving the total radiation dose in two fractions 40 min apart. When O_2 was present with the Ar, similar values were obtained with a fast, continuous dose and with fractionated doses. Another type of dose rate effect was observed when spermatogonia were treated. The dominant lethal percentages were higher when doses were fractionated in both Ar and in Ar+O_2 tests. (Essentially auth. summary)

529 Bateman, A. J., Chandley, A. C. EFFECTS OF x-RAYS ON FEMALE GERM CELLS OF Drosophila melanogaster. Mutation Res. 2, 6 (1965) 506-22.

Distal segments of the X-chromosome show reduced recombination after x-rays. This reduction is confined to eggs laid 6 d and more after irradiation and persists at least until the 14th day. It is roughly proportional to dose over the range 1 krad-8 krad. Proximal segments of the X(between f and the centromere) show increased recombination after x-rays. The increase is first evident in eggs laid 4 d after irradiation and persists at least until the 11th day. The maximum effect follows 4 krad. Intermediate segments show increased recombination at doses up to 4 krad and reduced recombination at higher doses. It is concluded that the increases and decreases in recombination following x-rays are independent effects with different dose dependences. The increased recombination is attributed to the direct induction of crossing-over in early oocytes or oogonia in synapsed regions. It is postulated that the reduction in recombination is due to the disruption of synapsis, beginning at the telomere and extending towards the centromere as the dose is increased. It is supposed that when the pairing of oogonial chromosomes is disrupted the disruption persists through to the oocyte. The sensitivities of the various stages of oogenesis to induced crossing-over, reduced crossing-over, non-disjunction and dominant lethals are compared. (Auth.)

530 Carlson, J. G., Gaulden, M. E. GRASSHOPPER NEUROBLAST TECHNIQUES. p. 229-76 of "Methods in Cell Physiology. Vol. I". Prescott, D. M., Ed. New York, Academic Press. 1964, 465p.

The selection of suitable species and various techniques (such as specimen collection, rearing, tissue culture) used in cytologic studies of grasshopper neuroblast, especially radiobiology experiments, are described. Methods of irradiation and observation of irradiated cells are reviewed. The closeness of these cells to the body surface makes them accessible to poorly penetrating radiations such as α-, β-, and u. v. -radiations. Grasshopper embryos may be exposed to the highly penetrating x- and γ-rays in vivo, i. e. within the intact chorion of the egg, or in vitro in cultures. Osmotic pressure of neuroblasts changes immediately after exposure to 100 R or more of x-rays. Culture medium isotonic to untreated cells is hypotonic to them after irradiation. With ^{32}P, neuroblasts can be exposed to a known amount of β-radiation. A method of treating neuroblasts with α-particles was developed. Because of the high LET and short paths of α-particles, it is necessary to use hanging-drop cultures. A radiation source prepared by electro-chemical deposition is described. Neuroblasts can be used for the experimental study of the effects of whole-surface irradiation. Either polychromatic or monochromatic u. v. radiation can be used to treat the neuroblast. Whole-cell irradiation of hanging-drop preparations of embryos is also described. Parts of the neuroblast can be irradiated with a microbeam of u. v. radiation. Various techniques for detection of modification of radiation effects are also outlined. To determine the effects of pretreatment and posttreatment with heat on x-ray-induced chromosome breakage, eggs are immersed in water at the temperature and for the time desired. The effects of O_2 on the mitotic response of neuroblasts to x-rays has been determined by exposing whole eggs to different concentrations of gaseous O_2 as well as to N_2 or Co_2. Observations on irradiated neuroblasts can be made on living cells in hanging-drop cultures or on fixed and stained cells. Time-lapse photography has also been used. Chemical, gas, and microdissection techniques are also discussed. Extensive supporting documentation is included.

531 Erickson, J. E. MEIOTIC DRIVE IN Drosophila INVOLVING CHROMOSOME BREAKAGE. Diss. Abstr. 25, 5 (1965) 2716-7.

This represents the first experimentally produced case of meiotic drive which has been analysed in considerable detail, both genetically and cytologically. A stock was isolated from an irradiated population of Drosophila melanogaster which showed meiotic drive, defined as the unequal recovery, in the products of meiosis, of the members of a pair of homologous chromosomes. Males of this stock produce an excess of X- over Y-bearing sperms, resulting in a sex-ratio of approximately two females to one male. The effect is due to a factor on the X-chromosome, in or near the proximal heterochromatin, and is subject to depressed expression. The basic effect is an action against the Y-chromosome. Cytological study shows fragmentation of the Y, usually delayed to the second division in its appearance. It is assumed that the fragments lead to gametic death, accounting for the differential production of X and Y sperms. Additional confirmation of the conclusion that a reduced recovery of the Y-chromosome, rather than a gain of the X-chromosome, is responsible for the observed sex-ratio, was obtained by tests with XYY males, carrying marked Y-chromosomes. Fertility is greatly reduced in comparison with normal stocks, and responds to temperature in a pattern similar to that of sex-ratio, maximum fertility corresponding to maximum recovery of female offspring. Cytological observations probably related to the low fertility are a high rate of non-disjunction, and first anaphase bridges involving both autosomes and sex chromosomes. (From DA)

532 Fahmy, O. G., Fahmy, M. J. RADIOSENSITIVITY OF THE STAGES OF SPERMATOGENESIS TO DIFFERENT MUTATIONS IN Drosophila melanogaster. Mutation Res. 1 (1964) 247-67.

The induction of sex-linked recessive lethals, XO males, and chromosome deletions were followed relative to non-disjunction (XXY females) and induced crossing-over in daily sperm samples from IX irradiated male D. melanogaster. Non-disjunction marked the sampling of meiotic spermatocytes, prior to and during anaphase I, and its yield was highest on the 10th-12th day, although a low rate occasionally occurred as early as the 8th, or as late as the 13th day. Accordingly, post-meiotic stages were mainly used during the first 9 d, and meiotic and pre-meiotic stages were sampled starting from the 10th d. Induced crossing-over marked the utilization of diploid germ cells and was substantially sampled on the 10th and later days. Small clusters of recombinants involving the same chromosome site occurred 12-13 d after treatment, possibly indicating the sampling of spermatogonia late in the mitotic cycle. The induction of sex-linked recessive lethals and XO males was high in the spermatid stages and decreased sharply in frequency with the increase in the rate of non-disjunction. The response for these mutations, therefore, was considerably lower in meiotic spermatocytes than in early spermatids. The mutation rate for the deletions (y^+ and B from the Y-chromosome) reached its peak before that of non-disjunction but remained high during the sampling of the latter aberrations. Radiosensitivity to the induction of deletions, therefore, although highest in the early spermatids, did extend to the late meiotic spermatocytes. (Auth.)

533 Grosch, D. S. BIOLOGICAL EFFECTS OF RADIATION. Bios 36 (1965) 55-62.

The effects of ionizing radiations at the cellular level are discussed, with particular reference to studies using Habrobracon.

534 Hannah-Alava, A. THE PREMEIOTIC STAGES OF SPERMATOGENESIS.* p. 157-226 of "Advances in Genetics. Vol. 13". Caspari, E. W., Thoday, J. M., Eds. New York, Academic Press. 1965, 378p.

Review article. The author considers maintenance of the germ line and spermatogonial multiplication, the chronometry of the various stages of spermatogenesis, and the genetic criteria for relating the temporal and spatial patterns of spermatogenesis. The radiosensitivity of spermatogonia is discussed in detail. Much of the work cited was done on Drosophila.

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* An earlier publication of the same title, not for general distribution, appeared as TID-21562, Turku Univ. (Finland). Dept. of Genetics. 1964, 91p.

535 Hsu, F. -T., Ma, S. T., Chen, T. C. THE DISTURBANCE BY x-RAYS TO THE MEIOSIS AND SPERMIOGENESIS OF MALE Locusta Migratoria manilensis Meyen. Acta ent. sin. 13, 5 (1964) 637-48. (In Chinese, with English summary)

536 Lefevre, G., Jr. THE MUTABILITY OF MATURE SPERM OF Drosophila melanogaster IRRADIATED* IN THE FEMALE AND IN THE MALE. Genetics 51 (1965) 381-90.

The mutability of fully mature, motile sperm of D. melanogaster was examined following comparable 4000 R irradiations of inseminated females and adult males. The frequency of sex-linked recessive lethal mutations induced in mature sperm irradiated in the female was found to be affected neither by the age of the male that provided the sperm nor by the length of time that the sperm had been mature before being utilized by the male. Thus, mature sperm, once in the female, exhibit a constant mutability. The mutation frequency observed following the exposure of inseminated females was significantly lower than the mutation frequency characteristic of sperm samples derived from the first mating after irradiation of 3- or 7-d-old males. The difference in the detected frequency of mutations induced in mature sperm under the two conditions of irradiation may be related to the fact that, when inseminated females are irradiated, both genomes of the F_1 progeny are exposed; whereas, only the paternal genome is exposed when adult males are irradiated. (Auth.)

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* (x-radiation)

537 Lefevre, G., Jr., Jonsson, U.-B. x-RAY INDUCED MUTABILITY IN MALE GERM CELLS OF Drosophila melanogaster. Mutation Res. 1 (1964) 231-46.

As the time interval between irradiation and the initial mating increases, the sperm samples consist of ever less homogeneous mixtures of cells that were at varying stages of maturity at the time of irradiation. If the male mates at a regulated pace after irradiation, sperm samples can be obtained that enable one to measure separately, and with reasonable accuracy, the mutability of mature sperm, intermediate and late spermatid stages, and early spermatids. Even so, unless each male in an experiment mates the same number of times each day, sampling of the various stages will become more and more asynchronous, as some males will produce sperm derived from stages quite different from those sampled at the same time from other males in the same experimental group. Then, if mutation frequencies are collected in terms of days after irradiation, they will not accurately reflect the mutability of any particular germ cell stage. When appropriate experimental procedures are followed, the mutability of mature, motile sperm is found to be as high, or higher, in male irradiations as in irradiations of inseminated females. The sex-linked recessive lethal mutation frequency characteristic of mature, motile sperm approaches 4%/1000 R. Immotile sperm stages such as intermediate and late spermatids have a much lower mutability, less than 2%/1000 R. Early spermatids again have a high mutability, probably exceeding that of motile sperm. The actual mutation frequency encountered at any time following irradiation reflects the proportion of the various kinds of irradiated germ cells in the sperm sample assayed. The precise proportion in any given sperm sample will be related to the age of the male at the time of irradiation, his previous mating history, the length of time that has elapsed between the irradiation and mating, and the number of inseminations that have ensued since the irradiation. The inherent mutability of male germ cells can be correlated with their physiological state at the time of irradiation. Thus, rapidly differentiating early spermatids are highly mutable and radiosensitive. Later, after the major structural modifications of the cell have been accomplished, the immotile intermediate and late spermatids exhibit a low mutability. Finally, in the terminal step in their differentiation the spermatids acquire motility, thereby becoming transformed into functional spermatozoa whose mutability is simultaneously reset to a high level. (Auth.)

538 Lindsley D. L., Sandler, L. MEIOTIC BEHAVIOUR OF TANDEM METACENTRIC COMPOUND X CHROMOSOMES IN Drosophila melanogaster. Genetics 51 (1965) 223-45.

Well marked tandem metacentric compound X-chromosomes of two structural types were synthesized, and their behaviour in crosses was investigated. In addition to the data from these newly synthesized tandem metacentrics, previously published data on other tandem metacentrics were considered. The following conclusions emerge from an analysis of tandem metacentric data. The data do not fit the hypothesis that nullo-X eggs (detected as exceptional patroclinous males) result from the exclusion of double second-anaphase bridges from the egg nucleus; such bridges, therefore, probably result in inviable zygotes. The data are compatible with the hypothesis that nullo-X eggs arise through the loss of a fraction of the newly generated single-ring X-chromosomes and that ring loss is lower in the progeny of tandem metacentric X-bearing females that carry a marked Y-chromosome fragment than of those that carry none. The exchange distribution in tandem metacentrics, as in other tandem compounds, is comparable with that of free X-chromosomes, and the coefficient of non-randomness approximates unity. (Auth.)

539 Mandl, A. M. THE RADIOSENSITIVITY OF GERM CELLS. Rev. Camb. phil. Soc. Biol. 39, 3 (1964) 288-371.

The literature is reviewed. Considerable work on insects is included.

540 Meisner, H. M. INFLUENCE OF TONICITY ON MITOTIC RECOVERY IN x-IRRADIATED GRASSHOPPER NEUROBLASTS. Diss. Abstr. 25, 4 (1964) 2182-3.

For abstract, see 541.

541 Meisner, H. M. INFLUENCE OF TONICITY ON MITOTIC RECOVERY IN x-IRRADIATED GRASSHOPPER NEUROBLASTS. Physiol. Zool. 38 (1965) 276-88.

The influence of tonicity and other factors on mitotic recovery from 25 or 50 R was examined in hanging-drop preparations of Chortophaga viridifasciata neuroblasts. 6-d embryos (38°C) were cultured in either an inorganic salt-glucose medium (Carlson's) or an amino acid-inorganic salts-glucose medium (Shaw's). In both the mitotic ratio of irradiated (50 R) to non-irradiated cells was reduced as tonicity was lowered. During the recovery period from 110 to 308 min, a 10% reduction of tonicity depressed the mitotic ratio 41% in Carlson's, and 85% in Shaw's medium. Under hypertonic conditions, neuroblast recovery from radiation was the same in both media. The higher pH of Shaw's medium (7.0 against 6.3) was the sole factor responsible for the lower mitotic ratio. Addition of egg yolk to cultures markedly enhanced the mitotic ratio after 50 R in either medium, but was less pronounced as tonicity increased. Addition of 3×10^{-5} M 2,4-dinitrophenol caused a slight reduction in mitotic rate in non-irradiated neuroblasts. After 25 R, however, the mitotic ratio of DNP treated cells during the recovery period was the same or markedly greater than the mitotic ratio of controls irradiated with DNP.

542 Nakajima, M. RADIATION EFFECTS ON GERM CELLS OF THE SILKWORM (In Japan). Annual Reports of Scientific Research Grants 1964, Ministry of Education: Radiation Effects – Cooperative Researchers, No. 13 (1965) 161-2.

543 Nakanishi, Y. H., Tamiko, I., Hatao, K. CYTOLOGICAL STUDIES ON THE RADIOSENSITIVITY OF SPERMATOGONIA OF THE SILKWORM. Idengaku Zasshi (Jap. J. Genet.) 40, Suppl. (1965) 49-67.

A study of morphological features of spermatogonia of about 20 000 silkworm larvae at various developmental stages in relation to their radiosensitivity led to the conclusion that there are some specific types of spermatogonia in the silkworm which exhibit different sensitivities to radiation. Detailed analyses of the radiosensitivity of spermatogonia were undertaken in order to obtain quantitative cytological information concerning radiosensitivity. Careful microscopical examinations of serial sections of the testes made possible the accurate identification of six successive generations or stages of spermatogonia: they are referred to as spermatogonia-I, -II, -III, -IV, -V and -VI, on the basis of the number of the spermatogonia within each gonocyst. The relative radiosensitivity of spermatogonia at different stages was determined by scoring the number of gonocysts containing pycnotic spermatogonia-I to -VI following irradiation with 1000 R of x-rays at a dose-rate of 300 R/min. After irradiation, spermatogonia VI showed the highest value in pycnotic incidence, while those -V to -I were progressively less in number. An autoradiographic study with ^{3}H-thymidine revealed that there was a significant difference in percentage of labelled gonocysts among different stages of pycnotic spermatogonia. It seems most probable that there is a definite correlation between radiosensitivity of different stages of spermatogonia and degree of DNA synthesis in the cells at the time of irradiation. Furthermore, the spermatogonia-VI were most sensitive, producing chromosome clumping in late prophase, and became progressively less sensitive toward early stages of spermatogonia. Evidence of selective killing of highly radiosensitive spermatogonia was observed in larvae in the late developmental stage, while in newly hatched larvae spermatogonia in the early stages, which form the bulk of the germ cells, are less sensitive. It seems probable that spermatogonia-VI are most sensitive to x-rays in producing pycnotic degeneration and chromosome clumping, and that so far as the scope of the present experiments is concerned, the sensitivity to radiation decreases as follows; spermatogonia-VI, -V, -IV, -III, -II and -I. (From auth.)

544 Oak Ridge National Lab., Tenn. Drosophila CYTOLOGY AND GENETICS. p. 47-59 of "Biology Division Semiannual Progress Report for Period Ending February 15, 1964". ORNL-3601. May 1964, 232p.

Progress is reported in studies of genetic damage in entire X-bearing and Y-bearing genomes x-irradiated in mature spermatozoa of Drosophila melanogaster; a search for sex-linked recessive lethals in D. melanogaster that can be transmitted by triploid females but not by diploid daughters; the effects of the amount and distribution of X-chromosome heterochromatin on x-ray-induced X-autosomal translocation frequencies; meiotic behaviour of tandem compound ring chromosomes and tandem metacentric compound X-chromosomes in Drosophila; preparation of a revised edition of the mutants of D. melanogaster; regulation of fourth chromosome nondisjunction by the length of a free X-duplication in D. melanogaster; the genetic explanation for the correlated appearance of diverse karyotype abnormalities within human kinships; spontaneous and x-ray-induced exchange in normal and inverted X-chromosomes in Drosophila females; abnormal chromosome behaviour associated with the mutant claret-nondisjunctional in Drosophila; and a study of mutant types at the notch locus in Drosophila. (NSA18:1964, 27004)

545 Oftedal, P. RADIOSENSITIVITY OF Drosophila SPERMATOGONIA. II PROTRACTED DOSES. Hereditas 51 (1964) 13-30.

On the basis of previous results obtained after acute treatments of Drosophila spermatogonia, a mathematical model for the cell population under irradiation was formulated. With this model, which is based on the assumption of variation in cell radiosensitivity with the mitotic cycle, and correlation between the sensitivities to killing and to mutagenesis, it is possible to predict that within a certain dose range, a higher frequency of scoreable mutations should be obtained with protracted doses than with acute. A test of these predictions, measuring the frequency of sex-linked recessive lethals after protracted exposure, is described. Experiments were first made with a ^{137}Cs source giving doses of 144 and 267 R over 8 h; subsequently, the effects of 300, 400, and 542 R/8 h were measured. The control mutation rate was 0.31 compared with 0.50, 0.66, 0.75, 0.40 and 0.38 for these respective doses. The frequencies of sex-linked recessive lethals found in the irradiated groups indicated an increase with dose up to about 300 R and a falling off for the higher doses of 400 and 542 R. The mutation frequencies obtained after protracted doses extended to higher values than those found after earlier acute treatments, but the general shape of the dose effect curve was the same. The value after 144 R/8 h was not different from those found after treatment with 25 R/min of x-rays. The value after 300 R/8 h was the highest obtained in studies of spermatogonial radiosensitivity. Comparison of the data with those previously obtained after acute treatments showed that the dose-rate effect expected on the basis of the model proposed was obtained. By protraction of doses over the relatively short period of 8 h, cell killing was apparently reduced to an extent that led to higher yields of observable mutations. The value for the mutagenic sensitivity e_{obs} for spermatogonia derived from the results was about 1.5×10^{-5} sex-linked recessive lethals/R. (NSA 19:1965, 10823)

546 Oftedal, P. THE RADIOSENSITIVITY OF Drosophila SPERMATOGONIA. I. ACUTE DOSES. Genetics 49 (1964) 181-93.

The frequency of sex-linked recessive lethals in D. melanogaster has been measured after irradiation of spermatogonia with 0, 55, 110, 160 and 300 R doses of 180 keV x-rays. A non-linear dose-effect relationship was found, with maximum effect of 0.14% lethals at 160 R, and practically no effect at 300 R. Differential killing in conjunction with sensitivity variations is invoked to explain the results. (Auth. summary)

547 Oftedal, P. RADIOSENSITIVITY OF Drosophila SPERMATOGONIA. III. COMPARISON OF ACUTE AND PROTRACTED IRRADIATION EFFICIENCIES IN RELATION TO CELL KILLING. Mutation Res. 1 (1964) 63-76.

The applicability of available data, discussed on the basis of 64 references to the literature, to the interpretation of radiation dose-effect curves for point mutations in terms of a mathematical model is considered. Heterogeneity in the exposed population as regards cell killing and mutation induction sensitivities is assumed, and a complete correlation between these sensitivities is postulated. The model is based on data from acute radiation treatment of Drosophila spermatogonia and predictions based on it have been found to hold for protracted exposures. The results of other investigations at low acute doses also appear to be compatible with the model. In general, it was found that low doses are more efficient than higher ones, when heterogeneous cell populations are exposed. The decrease in efficiency presumably takes place through the killing off of a class of highly sensitive cells. These cells are probably at a certain stage of the mitotic cycle, and may, in Drosophila spermatogonia, constitute about 10% of the total cell population. Low dose rates kill fewer of the sensitive cells, and therefore lead to higher mutation yields in an intermediate dose range, as shown by two previous investigations. Thus, it appears that the model described can be used to predict non-linear genetic dose-effect curves in treatments of heterogeneous cell populations with doses within the region of 1-3 times the LD50 for the most sensitive cells in the population. The slope of the curves will be steeper in the region of the lowest doses than in that of high doses. The model further predicts that with protracted doses, the same initial slopes will be found as for the lowest acute doses, but that the decrease in the steepness should take place at a relatively higher total dose. For a quantitative interpretation of a given dose-effect curve in terms of this model, it is necessary to have data on cell survival in the relevant dose region. For protracted treatments, normal cell cycle length as well as cell cycle disturbances under treatment should also be known. These conditions are not fulfilled at present for any material, so that the model may serve for the present mainly as a guide in planning further experiments and in curve fitting, as well as to indicate the limitations of the present understanding of the dynamics of genetic radiation effects. (NSA19:1965, 3940)

548 Parker, D. R. DIFFERENTIAL RADIOSENSITIVITY IN GERM CELLS OF Drosophila. p. 140 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

549(1) Sado, T. RECOVERY OF IRRADIATED SPERMATOGONIA OF THE SILKWORM AND THE STAGE LIMIT FOR THE PRODUCTION OF FUNCTIONAL SPERM. Rep. natn. Inst. Genet., Misima 10 (1959) 119.

550(2) Sado, T. SPERMATOGENESIS OF THE SILKWORM AND ITS BEARING ON RADIATION INDUCED STERILITY. J. Fac. Agric. Kyushu Univ. 12 (1963) 359-85.

A brief review is included on spermatogenesis in the silkworm, radiation effects on spermatogenesis, and radiation effects on silkworm germ cells. Studies were made on the relation between spermatogenesis of the silkworm and radio-induced sterility. It was concluded that irradiation of larvae in the early 5th instar causes firstly, a reduction in number of spermatozoa produced and secondly, the formation of non-functional sperm, resulting in the functional oligospermy of the treated insects. (NSA19:1965, 8865)

551(2) Sado, T. SPERMATOGENESIS OF THE SILKWORM AND ITS BEARING ON RADIATION INDUCED STERILITY. PART II. J. Fac. Agric. Kyushu Univ. 12 (1963) 387-404.

Normal spermatogenesis of the silkworm is described with special reference to the correlation between the developmental stages of the larvae and the germ cell stages and to the duration of the successive stages of spermatogenesis. Radiation responses of spermatogenic cells were investigated by means of fertility tests and histological and cytological observations on the irradiated testes (or germ cells). The experiment was designed to investigate the reasons for the seeming contradiction between the findings on mice and adult Drosophila on the one hand, and those of the silkworm on the other as to the cytological causes of radio-induced sterility. An attempt was made to establish the latest larval stage at which irradiation yields spermatozoa treated exclusively as spermatogonia. (NSA19:1965, 10831)

552(1) Shaw, E. I. THE RELATION OF THE COMPOSITION OF THE CULTURE MEDIUM TO MITOTIC ACTIVITY AND TO x-RAY INDUCED MITOTIC INHIBITION IN THE NEUROBLAST OF THE GRASSHOPPER, Chortophaga viridifasciata (de Geer). Ph. D. Thesis. Tennessee Univ., Knoxville. 1955.

553 Sobels, F. H. RADIOSENSITIVITY AND REPAIR IN DIFFERENT GERM CELL STAGES OF Drosophila. p. 235-55 of "Genetics Today. Proceedings of the 11th International Congress of Genetics, The Hague, Netherlands, Sep. 1963, Vol. 2". Geerts, S. J., Ed. Oxford, Pergamon Press. 1965.

Various factors are involved in determining the final yields of mutations and chromosome aberrations in different stages of gametogenesis, following irradiation. The mutational response to x-rays in sperm and spermatids under different conditions is presented schematically. After irradiation in N_2 followed by exposure to air or O_2 roughly equal mutation frequencies are obtained from the two stages, because repair is inhibited in sperm, but favoured in spermatids. Irradiation in O_2, on the other hand, always produces more mutations in spermatids than in sperm, because the repair process does not function; in addition, more initial damage is induced, and the O_2/N_2 enhancement ratio for premutational radiation damage is considerably higher in spermatids than in sperm. Pre-treatments with chloramphenicol or ribonuclease level off the differences between sperm and spermatids. The present position is summarized in the light of the author's own results and other data obtained under various conditions. (See also p. 271 for H. J. Muller's discussion of Sobels' findings of contrasting effects on Drosophila spermatids and spermatozoa.)

554 Traut, H. EVIDENCE FOR DIFFERENTIAL RADIOSENSITIVITY RATHER THAN RECOVERY IN SPERM SAMPLES FROM x-IRRADIATED Drosophila melanogaster MALES. Genetics 50 (1964) 167-71.

Sperm released the 1st day after the x-irradiation of 3- to 4-d-old males of D. melanogaster showed a higher mutation frequency than the 2nd day sperm. From a comparison of mutation frequencies of successive 1-d-broods from males which were mated immediately after irradiation with those from males which had been stored for 1 d before they were mated, it seems likely that the difference between the mutation frequencies of the 1st and 2nd day is caused by a relatively low initial radiosensitivity of the 2nd day sperm rather than by recovery from radiation damage of the 1st day sperm owing to the 1 d storage period. (Auth.)

555 Virkki, N. INSECT GAMETOGENESIS AS A TARGET. Agr. Sci. R. 3, 3 (1965) 24-37.

Usually, gametogenesis occurs in insects during the latter part of ontogenesis (pupae or young adults) but there are remarkable deviations even between subfamilies. Ambient factors like temperature and photoperiod may considerably modify gametogenesis even in one and the same species, especially when the altitude or latitude range is large. Contrary to extrachromosomal features of gametogenesis, the karyotype of a species remains constant. Factors of high sensitivity to radiation are large nuclei and chromosomes, a low chromosome number, acrocentry, a localized centromere, much heterochromatin, and a slow prophase. Thus the target size, the relation of chromatin amount to number, location, and kind of centromeres, promise of breakability, and duration of the intermitotic stages should be considered when aiming at optimal effects from irradiation. A knowledge of the cytology of gametogenesis is clearly desirable in planning treatments for inducing sterility or effects in subsequent generations.

See also:

514 Cytological damage associated with genetic mutations in Drosophila with betatron treatment. (Alexander, M. L., McKinley, K., 1964)

516 517 } Fertilization in Drosophila. II. Time of inactivation of gene effect. (Hildreth, P. E., 1965)

556 The occurrence of deletions in the X-chromosome under influence of ionizing radiations in the spermatogenesis of Drosophila melanogaster. (Abeleva, E. A., Potekhina, N. A., 1964)

583 The dose-dependence of X-chromosome loss and non-disjunction induced by x-rays in oocytes of Drosophila melanogaster. (Traut, H., 1964)

587 x-ray induced X-Y exchange and nondisjunction in Drosophila spermatocytes. (Wu, C-k., 1964)

588 X-Y nondisjunction and exchange induced by x-rays in primary spermatocytes of the adult Drosophila. (Zimmering, S., Wu, C. K., 1964)

597 Rates of visible mutations as related to the maturity of male germ cells of Drosophila melanogaster at the time of radiation. (Hannah-Alava, A., 1961)

608 The relationship between radiation dose and mutation frequency in spermatogonia of Drosophila melanogaster. (McSheehy, T. W., 1964)

613 Cytochemistry and cell reproduction. (Oak Ridge National Lab., Tenn., 1965)

614 The mutagencic efficiency of acute and of protracted irradiations of Drosophila spermatogonia. (Oftedal, P., 1964)

620 Radiosensitivity of spermatogonia. (Sävhagen, R., 1964)

627 Differential radiosensitivity as an explanation for so-called recovery in Drosophila sperm. (Trout, W. E., 1964)

629 Visible mutation frequencies induced in Mormoniella oocytes by x radiation. (Whiting, P. W., Ray, D. T., 1965)

642 Cytogenetic investigations on radiation and chemically induced dominant lethal mutations in oocytes and sperm of the screworm fly. (LaChance, L. E., Riemann, J. G., 1964)

643 Introduction of dominant lethal mutations in insect oocytes and sperm by gamma rays and an alkylating agent: dose-response and joint action studies. (LaChance, L. E., Crystal, M. M., 1965)

654 x-rays induced dominant lethals from irradiation of different stages of oögenesis in the silkworm. (Tazima, Y., Onimaru, K., 1959)

664 Change in the nature of radiation-induced mutation in the spermatids of Drosophila under the influence of arginine. (Abeleva, E. A., 1964)

665 Lethals in Drosophila spermatogonia after fractionated x-irradiation. (Baxter, R. C., 1964)

667 Genetic effect of combined x-ray and ethylenimine treatments. (Alexander, M. L., 1965)

701 Relative biological effectiveness of 14 MeV neutrons to γ-rays for inducing mutations in silkworm gonia. (Murakami, A., Kondo, S., 1964)

720 Features peculiar to the biological action of ultrafractional pulse radiation. (Skuratovich, A. A., Pravdina, G. M., 1965)

722 Post-radiation reduction of genetic damage in mature Drosophila sperm by nitrogen. (Sobels, F. H., 1964)

723 The role of oxygen in determining initial radiosensitivity and post-radiation recovery in the successive stages of Drosophila spermatogenesis. (Sobels, F. H., 1965)

726 Effect of temperature on radiation induced male sterility in the silkworm, Bombyx mori L. (Sugai, E., 1965)

727 Radiation mutagenesis in the silkworm. IV. Independence of radiation intensity as shown by induced sterility of spermatogenic cells. (Tazima, Y., 1958)

728 Independence of induced mutation-rate from radiation dose rate in the germ cells of hibernating silkworm embryo. (Tazima, Y., Onimaru, K., 1963)

729 Enhancement of radiation induced mutation frequency by post treatment of silkworm gonia with 5 bromodeoxyuridine. (Tazima, Y., Murakami, A., 1963)

735 Effect on genetic damage of post treatments given x-rayed Drosophila males. (Trosko, J. E., 1964)

738 The rate of gonadal mosaicism for lethals in late broods of Drosophila as compared with early when induced by x-rays, azaserine and quinarcrine mustard. (Altenburg, E., Browning, L. S., 1964)

767 Gametogenesis and radiation effects in the cereal leaf beetle, Oulema melanopa. (Hoopingarner, R. A., Kumararaj, S., 1965)

780 Fifth report from Norsk Hydro's Institute for Cancer Research for 1963-1964. (Norsk Hydro's Inst. for Cancer Research, Oslo., 1965)

784 Temporal pattern of the early stages of spermatogenesis of adult Drosophila melanogaster males after treatment with x-rays. (Puro, J. A., 1961)

801 Cytological effects of radiation on testes of the screw-worm fly, Cochliomyia hominivorax. (Riemann, J. G., 1964)

806 Dose fractionation and recovery from x rays in Rhodnius. (Baldwin, W. F., Shaver, E. L., 1964)

902 Heavy ion localization of sensitive embryonic sites in Tribolium. (Slater, J. V. et al, 1964)

919 Fast-neutron effects on productivity of young and old flour beetles, Tribolium castaneum Herbst, and alterations at different temperatures and after exposure of either or both sexes. (Erdman, H. E., 1965)

4. Chromosome Aberrations and Damage to Cellular Organelles (including Breakage, Crossing-Over, Large Deletions, and Translocations)

556 Abeleva, E. A., Potekhina, N. A. THE OCCURRENCE OF DELETIONS IN THE X-CHROMOSOME UNDER INFLUENCE OF IONIZING RADIATIONS IN THE SPERMATOGENESIS OF Drosophila melanogaster. Radiobiologiya 4, 3 (1964) 468-69. (In Russian). English Translation: AEC-tr-6406, Radiobiology 4, 3 (1964) 208-11.

The frequency with which deletions in the X-chromosome occur is more than 6 times greater in spermatid than in sperm, whereas the frequency of sex-linked recessive and dominant lethals is only 2.5 times greater. Arginine does not appear to influence deletion frequency. Deletion frequency is highest on 8th day after irradiation, i.e. when radiation-induced crossing-over begins in males. The increase in frequency therefore presumably occurs not in the spermatid but in the diploid cells, the primary spermatocytes. A high mutation rate is maintained on the 9th and 10th day post-irradiation, which falls off sharply on the 11th day, and is then maintained on the same low level on the 12th day. The 9th and 10th day appear to correspond to the period of preparation of germinal cells for meiotic division, i.e. the early and late prophases of meiotic division.

557 Asman, Sister Monica, Rai, K. S. RADIATION-INDUCED CHROMOSOMAL ABERRATIONS IN Aedes aegypti. Bull. ent. Soc. Am. 11, 3 (1965) 172. Abstr. 347. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

A reciprocal translocation, a primary trisomic and a pericentric inversion were detected in progeny resulting from irradiation of A. aegypti for four successive generations. The extra chromosome in the trisomic occurred more frequently as a univalent than a trivalent. Data on the disjunction of the interchange complex will be presented. (Abstr.)

558 Bowman, J. T., Jr. REVERSION OF THE WHITE-IVORY MUTANT IN *Drosophila melanogaster*. *Diss. Abstr.* *26*, 4 (1965) 1872.

The sex-linked recessive mutant white-ivory (w^i) has been found to revert to an allele that is inseparable by several criteria from wild type. The frequency of spontaneous reversions is about 5×10^{-5} loci in homozygous females and about 0.2×10^{-5} loci in males and in females that are heterozygous for deletions that include the white region. In females that are heterozygous for w^i and one of a variety of other white mutants, w^i reverts with a frequency comparable to that of homozygous females. Following treatment of females with 4000 R x-rays, w^i reverts equally frequently in homozygotes and deletion heterozygotes although such treatment only rarely induces reversion in w^i in males. Induced reversions are commonly recovered as clusters, indicating that they are of gonial origin. The phenomenon is not correlated with recombination of outside markers, nor is its frequency increased by heterozygosity for autosomal inversion complexes. Experiments on the mechanism of reversion gave results compatible with the hypothesis that w^i is associated with a tandem duplication of a portion of the white region and that reversion occurs by sister strand crossing over within a double loop formed by intrachromosomal pairing of the duplicated segments. The hypothesis leads to certain predictions concerning the behaviour of small tandem duplications and to an explanation of the reversion of w^i with high frequency. (From DA)

559 Brosseau, G. E., Jr. NON-RANDOMNESS IN THE RECOVERY OF DETACHMENTS FROM THE REVERSED METACENTRIC COMPOUND X CHROMOSOME IN *Drosophila melanogaster*. *Can. J. Genet. Cytol.* *6* (1964) 201-6.

Non-random recovery of x-ray-induced reciprocal detachment products from a reversed metacentric compound-X-chromosome (attached-X) was investigated. The study was restricted to detachments resulting from exchange with the Y-chromosome, the use of a doubly marked Y (B^SYy^+) permitting ready identification of all the detachments. The distribution of the exchange points along the Y-chromosome was determined by the use of the fertility genes as markers. The findings support the hypothesis that non-random disjunction favours the recovery of some detachment products over others. Thus asymmetrical dyads must be present at the second meiotic division and therefore the exchange yielding detachments must occur between chromatids at the four strand stage. About 70% of the detachments had the break in B^SYy^+ located in a region which is homologous to a portion of the X suggesting that these regions were synapsed at the time of exchange. These results suggest that a significant fraction of x-ray-induced detachments may represent induced crossing over in heterochromatin rather than translocation. (Auth.)

560 Grell, R. F. THE TARGET FOR IRRADIATION-INDUCED CHROMOSOME LOSS IN *Drosophila melanogaster* FEMALES. p. 59-60 of "Biology Division Semiannual Progress Report for Period Ending August 15, 1964". ORNL-3700, Oak Ridge National Lab., Tenn. Nov. 1964.

Results obtained with 4000 R of x-irradiation point to an identical, single target on each chromosome which is responsible for irradiation loss. Females had been used which carried two nonhomologues of about equal size, one an extra free fourth chromosome and the other a small, free, X duplication, as well as the two normal X's.

561 Halkka, O. x-RAY-INDUCED CHANGES IN THE CHROMOSOMES OF *Limotettix* (HOMOPTERA). *Chromosoma* *16*, 2 (1965) 185-191.

Male *L. striola* were irradiated with a 400 R dose of x-rays. This treatment produced a variable number of chromosome fragments per cell. These fragments survived for 7 d, which is probably equivalent to more than one cell generation. A striking difference was observed in the manifestation of irradiation effects at the anaphase stages of the two maturation divisions. At the first division anaphase, bridge formations and laggard chromosomes were frequently found, while both these types of disturbance were practically absent at the second division. The conclusion was reached that all the peculiarities of irradiated leafhopper testicular cell progenies are best explained if it is assumed that 1) the chromosomes are holokinetic, and 2) the mode of meiosis is prereductional. (From auth. summary)

562 Hannah-Alava, A. THE BROOD-PATTERN OF x-RAY-INDUCED MUTATIONAL DAMAGE IN THE GERM CELLS OF *Drosophila melanogaster* MALES.* *Mutation Res.* *1* (1964) 414-36.

From the results of two experiments, comparisons were made of the frequencies of induced cross-overs in the third chromosome and three types of mutations (visibles at nine specific third chromosome loci, dominants and *Minutes* in all chromosomes) in successive broods of offspring from *D. melanogaster* males mated singly and sequentially up to 24 d following treatment with 3000 R x-rays. The highest frequency of cross-overs was in the 10 - 11 d broods, but large and continuing clusters were first found in the 12 - 13 d broods. Each mutational type, with the probable exception of the dominants, had a characteristic brood curve of mutation frequencies, but all were similar in that the rates were higher for spermatids (4 - 6 d) than for mature sperm (1 - 3 d). With one exception, the highest rates were in the 6 - 8 d broods, but as this was the period of excessive sterility the differences may not be significant. The rates in the post-sterile broods were substantially lower than the rates in the pre-sterile broods. The evidence supports the concepts of a stem-cell mechanism for maintenance of the germ line in *D. melanogaster* males, and points to the probability that the size and distribution of cross-over clusters is a reliable criterion for relating the temporal and spatial pattern of the spermatogonial stages. On the basis of this criterion, the 9 - 11 d broods, in all probability, were derived primarily from definitive, the 12th d brood from both definitive and predefinitive, and the later broods from predefinitive spermatogonia. Since the clusters of mutations were smaller than the cross-over clusters and seldom continued for more than two broods, it may be that radiogenetic damage to a predefinitive spermatogonium is accompanied by damage that leads to lethal loss of the cell after one or two predefinitive divisions. The progressive decrease in frequency of cross-overs and mutations in successively later post-sterile broods has been interpreted as the consequence of both random and lethal loss of the mutated predefinitive spermatogonia, but progressive repopulation of the testes by non-mutated cells could not be ruled out as a contributing factor. (Auth.)

563 Hannah-Alava, A. THE BROOD-PATTERNS OF MUTATIONS AND CROSSING-OVER RECOMBINANTS IN SUCCESSIVE BROODS OF F_1 OFFSPRING FROM MALES TREATED WITH 3000 R OF x-RAYS. Period covered: Nov. 1, 1959 - Oct. 31, 1964. TID-21608, 3p.

Results are reported from studies on the frequencies of induced chromosome crossing-over recombinations and three types of visible mutations in successive broods of offspring from *Drosophila melanogaster* males that had been treated with 3000 R of x-rays and mated to females with appropriate third-chromosome markers for detecting mutations and/or crossing-over recombinants. (NSA 19: 1965, 10791)

564 Lewis, E. B. THE GENETIC AND CYTOLOGICAL EFFECTS OF HIGH ENERGY RADIATION. p. 128 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

565 Lindsley, D. L. CYTOGENETIC EFFECTS OF x RAYS ON WHOLE GENOMES OF *Drosophila*; THE INDUCTION OF SMALL DEFICIENCIES INCLUDING THE y^+ LOCUS. p. 108-9 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

566 Lucchesi, J. C. THE NATURE OF INDUCED EXCHANGES BETWEEN THE ATTACHED-X AND Y CHROMOSOMES IN *Drosophila melanogaster* FEMALES. *Genetics* *51*, 2 (1965) 209-215.

Evidence has been presented that x-ray-induced exchanges between an attached-X and marked Y-chromosomes are not translocations but are influenced by the homologies existing between these two chromosomes and are probably the result of crossing-over. This evidence was based on a comparison of the distribution of breaks on Y^L when this arm is involved in an exchange with the attached-X and when it is involved in translocations and gross deletions. More critical evidence was obtained by comparing the relative proportion of exchanges involving Y^S (40% of all detachments) with the relative proportion of translocations and gross deletions involving the same arm (16% of all Y fragments). (Auth. summary)

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* An outline of the same title appeared in p. 139 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

567 Nicklas, R.B. CHROMOSOME VELOCITY DURING MITOSIS AS A FUNCTION OF CHROMOSOME SIZE AND POSITION. *J. Cell. Biol.* *25*, 1, Pt. 2 (1965) 119-35.

Chromosome velocity has been studied in living *Melanoplus differentialis* spermatocytes by phase contrast cinemicrography. *Melanoplus* chromosomes (and bivalents) differ in length by as much as 1 : 3.5. As expected, no size-dependent velocity differences were detected in anaphase, and this is also shown to be true for the less predictable movements during prometaphase congression. The size of the X-chromosome can change during observation following x-irradiation, but this is equally without influence on velocity. However, an effect of position on velocity is found in both prometaphase and in anaphase: the chromosomes furthest from the central interpolar axis move 25% faster than more central chromosomes. A simple mechanical model relating frictional resistance and mitotic forces to chromosome velocity is discussed in detail. Calculations from the model suggest that a significant difference in the force acting on a large, as compared with a small chromosome is necessary to account for the observed similarity in velocity. Therefore, it is concluded that the mitotic forces are so organized or regulated that velocity is, within limits, independent of load. The implications of velocity-load independence in relation to the molecular origin of mitotic forces are discussed. (Auth.)

568 Oak Ridge National Lab., Tenn. *Drosophila* CYTOLOGY AND GENETICS. p. 47-60 of "Biology Division Semiannual Progress Report for the Period Ending February 15, 1964". ORNL-3601. May 1964, 232p.

This section deals with total radiation damage to entire genomes; a search for sex-linked recessive lethals in *D. melanogaster* than can be transmitted by triploid females but not by diploid daughters (x-rays being used in the experimental series), effects of the amounts and distribution of X-chromosome heterochromatin on x-ray-induced X-autosomal translocation frequencies; and spontaneous and x-ray-induced exchange in *Drosophila* females. The induction of chromosome puffs in *Drosophila* was studied with ribonuclease (p. 63), and results are reported on amino acid and uridine incorporation in salivary glands treated with RNase (p. 65).

569 Oak Ridge National Lab., Tenn. *Drosophila* CYTOLOGY AND GENETICS. p. 58-62 of "Biology Division Semiannual Progress Report for the Period Ending August 15, 1964". ORNL-3700. Nov. 1964, 197p.

This section deals with the detection and localization of recessive lethals at a specific locus; the target for irradiation-induced chromosome loss in females; distributive pairing in translocation heterozygotes; exchange in adjacent tandem duplication; cytology of x-ray-induced translocations; generally induced mutations in *Drosophila*; and mutants.

570 Oak Ridge National Lab., Tenn. *Drosophila* CYTOLOGY AND GENETICS. p. 62-65 of "Biology Division Semiannual Progress Report for Period Ending July 31, 1965". ORNL-3853. Nov. 1965, 222p.

Revision of a detailed catalogue of all the genetic material available for studies with fruit flies was continued. Results are reported from studies of cross-over suppressing translocations in populations of *D. melanogaster.* Males were exposed to 4000 R x-radiation and mated to marker females and individual females were back-crossed to marker males. The polytene chromosomes of 75 of these arrangements were examined. Data are included from studies on the timing of spermatogenesis in *Drosophila* with scintillation counting of ^{3}H-thymidine in inseminated females; the effects of chromosome size on the frequency of x-radiation-induced non-disjunction; and indicating that the Notch locus in *Drosophila* is a cistron. (From NSA 20:1966, 6778)

571 Oster, I.I. FILICIDAL Y CHROMOSOMES. *Genetics* *50*, 2 (1964) 274. Abstr.

x- and γ-irradiation of mature spermatozoa of *Drosophila melanogaster* containing a Y-chromosome marked with small segments of the X, $sc^8(y^+ ac^+)Y^S \cdot Y^L (su\text{-}f^+ B)B^S$ (Brosseau, Drosph. Inf. Serv. 32 : 1958, 115) yielded 36 structurally altered but fertile Y-chromosomes which were detected genetically by loss of either or both of the terminal markers. Eight out of 11 cases involving loss of both y^+ and B^S proved to be ring-shaped upon cytological examination; also seven of the eight rings had lost both ac^+ and $su\text{-}f^+$, while one still retained $su\text{-}f^+$. Attempts to utilize these ring Y-chromosomes for the construction of new stocks revealed that introduction of each of the eight, as well as the only other ring-shaped Y in existence containing all the factors necessary for fertility, Y^c: bw^+ designated "MYR" (Oster and Iyengar, Drosoph. Inf. Serv. 29 : 1955, 159), into certain strains via the male results in the death of practically all the male progeny during early embryogenesis. Of more than 100 strains subsequently tested, including wild types from various localities and mutants of diverse kinds, 10% proved to be consistently sensitive to such killing of their male offspring. On the other hand, introduction of these "filicidal" Y-chromosomes via the female (i.e. using attached-X-chromosomes) into a sensitive strain does not result in the death of the male offspring. Conversion of the rings into rods also abolishes the effect. All of our other stocks involving structural changes of the Y excluding ring-formation, as well as a ring-shaped chromosome involving the long arm of the Y and its fertility factors but lacking Y^S and its fertility factors, Y^{LC} (Muller, Drosoph. Inf. Serv. 22: 1948, 73), do not exhibit this phenomenon. This curious incompatibility has never been reported before for the Y-chromosome, which is considered to be relatively inert genetically in *Drosophila.* While position effects and cytoplasmic interactions appear to be implicated, the exact mechanism underlying the action of these "filicidal" Y-chromosomes has yet to be elucidated. (Abstr.)

572 Parker, D.R. CHROMOSOME PAIRING AND INDUCED EXCHANGE IN *Drosophila.* *Mutation Res.* *2*, 6 (1965) 523-9.

Fragments of Y-chromosomes were induced by irradiating* attached-X *D. melanogaster* females carrying a doubly marked Y-chromosome, and detected by loss of one of the Y markers. Slightly more than half of the 55 fragments recovered showed linkage of fourth-chromosome markers, implying a high frequency of association of Y and fourth-chromosomes in oocytes. Where such fragments were shown to have Y centromeres, a high incidence of non-disjunction from the attached X was found, suggesting that exchange between heterologues leads to their separation at Anaphase I, and frequent non-disjunction from their regular pairing partners. Lucchesi's assumption that fragments are not pairing-dependent for their formation is thus invalidated. It is suggested that non-reciprocal exchanges induced between the two Y arms may account for other fragments, these likewise being pairing-dependent. There is as yet no evidence that any exchange process occurs with appreciable frequency in oocytes in stage seven or earlier that is not dependent on regular, frequent associations of the chromosomes involved. (Auth.)

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* 3000 R of x-rays within 12 h of emergence, at ~400 R/min.

573 Ramel, C., Goldman, E., Kjellstroem, T. A NOTE ON INTERCHROMOSOMAL EFFECTS OF TRANSLOCATIONS AND DEFICIENCY ON CROSSING OVER IN *Drosophila melanogaster.* *Hereditas* *52* (1964) 171-5.

Interchromosomal effects on crossing-over were studied in *D. melanogaster* with the use of two 2, 3-translocations and one deficiency in chromosome two. The translocations and deficiency were induced by x-irradiation of spermatozoa in males. The translocations showed an increased recombination, the net result of which was a relative increase of the map length with 26% for T 7 and with 37% for T 10. The change of crossing-over was significant for all the intervals except the first one, y-ec, where T 7 did not show any significant difference versus the control. The pattern of increase seemed rather uniform along the X-chromosome. The deficiency data indicate no or, at most, a weak interchromosomal effect on crossing-over. Only one interval, ct-v, showed a difference versus the control, reaching a significance at the 5% level. The total map length was not affected to any appreciable extent. (NSA 19: 1965, 15090)

574 Ratty, F.J. THE MUTABILITY OF LOCI IN AN X-CHROMOSOME DUPLICATION OF *Drosophila melanogaster.* *Genetics* *52*, 6 (1965) 1113-7.

Experiments reported in this paper indicate that genes located in an insertional translocation mutate at a higher frequency than in their normal configuration, and that this increase appears to be related to both the heterochromatic involvement of the insertion and to chromosomal heterozygosity.

575 Reddi, O.S. INTERACTION OF CHROMOSOME BREAKS IN THE SPERMATOZOA OF *Drosophila* INDUCED BY x RAYS AND FAST NEUTRONS. *Drosoph. Inf. Serv.* *39* (1964) 88.

576 Roberts, P. SPONTANEOUS AND x-RAY INDUCED EXCHANGE IN *Drosophila melanogaster.* Presented at the "15th Annual Meeting of the American Institute of Biological Sciences, Boulder, Colo., 23-28 Aug. 1964".

577 Ronen, A. INTERCHROMOSOMAL EFFECTS ON SOMATIC RECOMBINATION IN Drosophila melanogaster. Genetics 50, 4 (1964) 649-58.

Somatic crossing-over was studied in y/sn females. The frequency of single and twin spots per fly was higher in the presence of the autosomal inversions Curly and Diahaete, than in a control group where the autosomes were structurally and genetically homozygous. The spot-frequency was even higher in females which had been irradiated as 3rd instar larvae with 1170 R of x-rays. The data indicate that both spontaneous and induced recombination are restricted to the proximal part of the chromosome. In the irradiated group, there were fewer induced spots in the inversion-carrying females than in the normal ones. It is suggested that centric pairing in the X-chromosome, and therefore its change to undergo induced somatic recombination, are impaired in the presence of autosomal inversions. (Auth.)

578 Sävhagen, R. INDUCED CROSSING OVER AND TRANSLOCATIONS IN SPERMATOGONIA OF Drosophila melanogaster. Drosoph. Inf. Serv. 39 (1964) 109-10.

579 Sävhagen, R. INDUCED CROSSING OVER IN LARVAL SPERMATOGONIA OF Drosophila melanogaster. Drosoph. Inf. Serv. 39 (1964) 110-11.

580 Sävhagen, R., Kemmer, M. INDUCED CROSSING OVER IN LARVAL SPERMOTOGONIA OF Drosophila melanogaster. Drosoph. Inf. Serv. 39 (1964) 110.

581 Tikhomirova, M. M. NON-DIVERGENCE OF CHROMOSOMES UNDER THE INFLUENCE OF x-RAYS OF VARIED HARDNESS AND INTENSITY. p. 44-58 of "Studies in Genetics". JPRS-31514. 115p. Translation: Issled. Genet. 2 (1964) 56-64.

During the irradiation of female imagoes of Drosophila the predominance of XO males is observed in the progeny in comparison with XXY females (3.44 ± 0.147% and 0.20 ± 0.034%). The hard x-rays applied in the experiment (200 kV) cause not only actual but also potential and long-duration breaks (∤1 h), which is confirmed by the great frequency of the appearance of males (2.81 ± 0.163%) in this group in comparison with the frequency of their appearance in a group where the irradiation was effected with soft rays (1.84 ± 0.124% and 0.97 ± 0.128%). In addition to this, the males appear with great frequency (4.45 ± 0.379%) in a group where there is additional high temperature (37°C) within 1 h after the irradiation with hard rays. The effect of the hard-ray after-effect is detected for a period of 1 h, and not detected within 2 h after irradiation. Soft rays (voltage of 50 kV) cause the appearance of rapidly repairable chromosome breaks which are maintained for less than 30 min, a fact which is corroborated by the absence of after-effect (1.84 ± 0.124% and 1.76 ± 0.145%; 0.97 ± 0.128% and 1.29 ± 0.161%) and by the effect of the intensity. Soft rays of high intensity (1932 R/min) are more effective (1.84 ± 0.124%) than those same rays of lesser intensity. Possible mechanisms involved in the primary non-divergence of X-chromosomes during irradiation of Drosophila females are discussed. (NSA 20:1965, 3714)

582 Tikhomirova, M. M., Dubrova, S. E., Yanoosh, I. M. A COMPARATIVE STUDY OF THE RESULT OF RADIATION AFTER-EFFECTS ON CHROMOSOMAL NON-DIVERGENCE. p. 59-64 of "Studies in Genetics". JPRS-31514. 115p. Translation: Issled. Genet. 2 (1964) 65-68.

x-rays caused an after-effect on the non-divergence of X-chromosomes in two comparable lines of Drosophila. The after-effect result proved to be higher in the radioresistant w^a line in comparison with the Canton-S line. (NSA 20:1965, 3715)

583 Traut, H. THE DOSE-DEPENDENCE OF X-CHROMOSOME LOSS AND NON-DISJUNCTION INDUCED BY x-RAYS IN OOCYTES OF Drosophila melanogaster. Mutation Res. 1 (1964) 157-62.

The dose-dependence of X-chromosome loss and non-disjunction induced by x-ray was investigated in oocytes of D. melanogaster. The frequency of X-chromosome loss increases faster than linearly with dose, suggesting that this effect is based on both one and two hit events. Whereas the induction of single non-restituting chromosome breaks seems to be a plausible explanation for at least part of the one hit events, the two hit component, though statistically highly significant, is more difficult to interpret. One possibility, the induction of large deletions in the maternal X which would require two breaks and simulate the loss of the whole X-chromosome, was ruled out by special experiments. The dose-effect relationship for non-disjunction seems too complicated to permit a simple hit explanation. Perhaps radiation-induced stickiness of the chromosome surface, an effect probably not caused by individual hits, prevents the X-chromosomes from separating at meiosis. Both the X loss and non-disjunction frequency show a stepwise increase with x-ray dose. Tentative explanations for this effect are given. (Auth.)

584(2) Volchkov, Yu. A., Aleksandrov, Yu. N. DEPENDENCE OF FREQUENCY OF OCCURRENCE OF PHENOCOPIES ON x-RAY DOSE. Vest. leningr. gos. Univ., Ser. Biol. 4 (1963) 95-105. (In Russian, with English summary)

Dependence of occurrence frequency of phenocopies on x-ray dose in Drosophila was studied for the purpose of comparison with corresponding data, available for mutations. Doses from 200 - 6000 R were used (altogether 17 different doses). The curve of the dependence, studied in the dose range from 200 - 3000 R statistically reliably does not differ from the exponential curve, thus similar to that of large chromosomal aberrations. Comparison of data concerning the occurrence of phenocopies and survival of pupae under different exposure doses as well as comparison of occurrence frequencies of phenocopies in males and females brings to the conclusion that there exists definite correlation between general radiation sensitivity of organisms and their predisposition to the occurrence of phenocopies, which also allows to draw and analogy between phenocopies and mutations, induced by ionizing radiation. (Auth.)

585 Warters, M. X-AUTOSOMAL TRANSLOCATIONS OF Drosophila melanogaster. p. 102-3 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

586 Williams, B. J. CYTOLOGY OF x-RAY-INDUCED TRANSLOCATIONS. p. 61-2 of "Biology Division Semiannual Progress Report for Period Ending August 15, 1964". ORNL-3700, Oak Ridge National Lab., Tenn. Nov. 1964.

587 Wu, C.-k. x-RAY INDUCED X-Y EXCHANGE AND NONDISJUNCTION IN Drosophila SPERMATOCYTES. Drosoph. Inf. Serv. 39 (1964) 126-7.

588 Zimmering, S., Wu, C.-k. X-Y NONDISJUNCTION AND EXCHANGE INDUCED BY x RAYS IN PRIMARY SPERMATOCYTES OF THE ADULT Drosophila. Genetics 49 (1964) 499-504.

x-Irradiation of primary spermatocytes of adult yv/$B^S Yy^+$ Drosophila melanogaster males was demonstrated to produce a greater proportion of X-Y exchanges than X-Y non-disjunction. This result is consistent with the previous findings of Zimmering and Wu (see II/334) following irradiation of the prepupal testis, but is in disagreement with those reported by Sävhagen (ibid, 1017) and by Strangio (ibid, 1022, 1023) from experiments on adult males. (From auth.)

589 Zimmering, S., Kirshenbaum, G. RADIATION INDUCED DELETIONS IN SPERMATIDS AND SPERMATOCYTES OF Drosophila. Z. VererbLehre 95, 4 (1964) 301-5.

Males of the composition $X^{C2}/B^S Yy^+$ were collected as prepupae, aged an additional 48 h, then irradiated with 1000 R of x-rays and brooded individually for 8 d with three virgin ywf females each day. Analysis suggests that brood d 1-3 represent the recovery of cells which were predominantly spermatids at the time of treatment, those from brood d 4-6 predominantly spermatocytes, and those from brood d 7-8 predominantly spermatogonia. The highest frequency of loss of individual Y-markers and "X0" males, as well as the smallest F_1 population size was found in broods 5 and 6, and especially in brood 6. Further analysis suggests that the vast majority of individual Y-marker losses recovered from diploid cells (spermatocytes, spermatogonia) arose independent of inter-Y arm exchange and Y-autosome translocations. In general, the data confirm the suggestive results of other investigators that deletions are recovered most readily from spermatocytes than from any other stage in spermatogenesis. (Essentially auth. summary)

See also:

527 The effect of x-irradiation on spermatogenesis in Drosophila melanogaster Meigen. (Abro, A., 1964)

529 Effects of x-rays on female germ cells of Drosophila melanogaster. (Bateman, A. J., Chandley, A. C., 1965)

530 Grasshopper neuroblast techniques. (Carlson, J. G., Gaulden, M. E., 1964)

532 Radiosensitivity of the stages of spermatogenesis to different mutations in *Drosophila melanogaster.* (Fahmy, O. G., Fahmy, M. J., 1964)

538 Meiotic behavior of tandem metacentric compound X chromosomes in *Drosophila melanogaster.* (Lindsley, D. L., Sandler, L., 1965)

544 *Drosophila* cytology and genetics. (Oak Ridge National Lab., Tenn., 1964)

596 A study of gene and chromosome changes induced by ionizing radiations in *Drosophila melanogaster.* (Godfrey, R. K., 1964)

604 "Yanders effect" - A re-examination. (Kishin, A. F., 1965)

611 The influence of radiation in altering the incidence of mutations in *Drosophila* (1963-64). (Muller, H. J., 1964)

616 Temporal distribution of x-ray induced recessive lethals and recombinants in the post-sterile broods of *Drosophila melanogaster* males. (Puro, J., 1964)

620 Radiosensitivity of spermatogonia. (Sävhagen, R., 1964)

622 Radiation and mutation rate. (Stern, C., 1964)

638 Structures of salivary chromosomes and their contribution to the problem of evolution. (Frizzi, G., 1961)

645 Male sterilizing mutations in *Drosophila* and the lesion in spermatogenesis causing sterility. (Lindsley, D. L., 1964)

666 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, M. L., 1964)

674 x-ray damage as measured by dominant lethals, sex-linked recessive lethals and translocations in *Drosophila melanogaster* and oxygen and argon as its modifying factors. (Elequin, F. T., 1965)

683 The effect of cold pretreatment on radiation effects as related to age in *Drosophila melanogaster.* (Iyengar, S. V., 1964)

685 Effects of storing x-rayed spermatozoa on the frequency of translocations and sex-linked lethals in *Drosophila melanogaster.* (Khishin, A. F. E., 1963)

694 The failure of sulphhydryl compounds, AET, MEA, and glutatione to protect against x-ray induced chromosome aberrations in male *Drosophila.* (Mittler, S., 1964)

695 Studies of chemical protection against radiation induced genetic aberrations. (Mittler, S., 1964)

696 Studies of chemical protection against radiation induced chromosome aberrations. Final Report, September 1, 1961 - August 31, 1965. (Mittler, S., 1965)

698 ATP and radiation induced chromosome breakage in *Drosophila.* (Mittler, S., U, R., 1965)

706 Influence of interaction between EDTA and x-rays on mutation and crossover frequencies in *Drosophila melanogaster.* (Ondrej, M., 1965)

709 Occurrence of crossing over in *Drosophila* males under the influence of vibration, acceleration and γ-irradiation. (Parfenov, G. P., 1964)

712 Genetic effects of fast neutrons from nuclear detonations. Projects 23.4 - 2314 and 23.16 of operation upshot-knothole. (Plough, H. H., Ed., Sheppard, C. W., Ed., 1954)

714 Lack of mutagenic effect of irradiated *Drosophila* medium. (Reddi, O. S. et al., 1965)

715 Genetic effects of cosmic radiation in *Drosophila melanogaster.* (Reddi, O. S., Sanjeeva Rao, M., 1964)

721 The effect of post-treatment with N_2 or O_2 on the frequencies of recessive lethals and translocations produced by irradiation in N_2 or O_2. (Sobels, F. H., 1963)

722 Post-radiation reduction of genetic damage in mature *Drosophila* sperm by nitrogen. (Sobels, F. H., 1964)

736 Induced mutation process - The effect of high temperature after irradiation on the frequency of occurrence of lethal mutations and chromosomal breaks. (Vatti, K. V., Yanoosh, I. M, 1964)

739 The sensitivity of the male germ cells of *Drosophila* to methyl methanesulphonate. (Bateman, A. J., Chandley, A. C., 1964)

743 Differential induction of chromosome deletions by natural and synthetic macromolecules in *Drosophila melanogaster.* (Fahmy, O. G., Fahmy, M. J., 1965)

746 On the mutagenic effects of x-radiation, *N*-nitroso-*N*-methyl-urethan, and *N*-nitrosomorpholine in *Drosophila melanogaster.* (Henke, H. et al., 1963/64)

750 Structural changes in chromosomes induced by malachite green. (Keyl, H.-G., Werth, G., 1959)

754 Phase cinematography studies on the effects of radiation and of some chemicals on cells and chromosomes. (Nakanishi, Y. H., Makino, S., 1964)

757 A comparison of genetic changes induced by a monofunctional and a polyfunctional alkylating agent in *Drosophila melanogaster.* (Snyder, L. A., Oster, I. I., 1964)

810 Genetic effects from simultaneous irradiation of immature and mature *Drosophila virilis* males. (Clayton, F. E., 1965)

878 Genetic and non-genetic radiation effects on *Drosophila* eggs. (Ulrich, H., Würgler, F. E., 1964)

902 Heavy ion localization of sensitive embryonic sites in *Tribolium.* (Slater, J. V. et al., 1964)

930 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level radiation. (Blaylock, B. G., 1965)

937 Lethal and semilethal chromosomes in irradiated experimental populations in *Drosophila pseudoobscura.* (Mourad, A. E. -K. M., 1964)

950 Radiation effects on *Chironomus tentans.* (Auerbach, S. I., 1964)

954 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation. (Blaylock, B. G., 1963/64)

955 Chromosomal aberrations in a natural population of *Chironomus tentans* exposed to chronic low-level environmental radiation. (Blaylock, B. G. et al., 1964)

959 Effects of radiation on competitive insects. (Erdman, H. E., 1964)

5. Recessive Mutations. Visible Mutations. Subvital and Sex Ratio Effects

590 Baldwin, W. F. VISIBLE MUTATION FREQUENCIES IN *Dahlbominus* OOGONIA PRODUCED BY ACUTE x-RAYS AND CHRONIC γ-RADIATION. *Mutation Res.* *2* (1965) 55-59.

In *Dahlbominus*, haploid males from unmated diploid females exhibit a small but significant difference in frequency of eye-colour mutations following acute or chronic irradiation of oogonia. One experiment on quality of radiation did not show any significant difference in frequency of mutations induced by 2 MVp and 300 kVcp radiation. A 2 MVp x-ray machine and a ^{60}Co-source were used. (Essentially auth. summary)

591 Baldwin, W. F., Shaver, E. L., Wilkes, A. MUTANTS OF THE PARASITIC WASP *Dahlbominus fuscipennis* (Zett.) *Can. J. Genet. Cytol.* *6* (1964) 453-66.

The main phenotypic effects of 12 visible mutants are reported in the arrhenotokous wasp, *D. fuscipennis* (Zett.) (Hymenoptera: Eulophidae). All but two of the mutations occurred among haploid males following irradiation* of wild females, the others during pedigree breeding of irradiated stock. Eight of the mutations affected pigmentation of the eyes or body, three produced morphological abnormalities in the wings and antennae and one reversed the sex ratio. All but the last one were controlled by recessive factors, each of which has been assigned a name and symbol. The sex reversing factor was dominant and sex-limited, being transmitted by females to their sons. Although tests for linkages between the mutations have not been completed, in initial crosses between four of the "bright" eye-colours and the wing mutations segregation was independent indicating that these arose as separate mutations. An account is given of the life history of the species and a description of the adult and immature stages of the wild stock as a basis for comparison with the mutant lines. A simple method is given for rearing large numbers in the laboratory. (Auth. summary)

592 Chandra, H. G. S. CYTOGENETIC STUDIES FOLLOWING HIGH DOSAGE PATERNAL IRRADIATION IN THE MEALY BUG, *Planococcus citri* (Risso). *Diss. Abstr.* *25*, 4 (1964) 2423.

When females of *P. citri* are mated to heavily irradiated males (60 000-90 000 rep), the progeny is largely female and few or no sons survive, whereas the reverse is true when males irradiated with lower doses (16 000 R) are used. The daughters that develop after heavy paternal irradiation all have unbroken chromosomes and they are therefore gynogenetic. The origin, development, chromosome constitution and breeding behaviour of these gynogenetic females have been studied. The majority of these females were triploid (3N = 15), some diploids and a few 3n-2n and 2n-n mosaics. The triploid polar body derivatives carry on a successful embryogeny when the zygote nucleus is unable to do so because of the heavily damaged paternal set. The chromosomes of mealy bug are holokinetic and consequently the paternal set, in spite of its heavy damage is not eliminated easily. It manages to divide with the undamaged maternal chromosomes but does not always segregate as successfully. Restitution, fragment loss, and sticky bridges were some of the mitotic abnormalities observed in these embryos. Most of the gynogenetic diploids probably arise through a doubling of the maternal contribution to the zygote during early cleavage division.

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* x- and γ-radiation, cf. Radiat. Res. *17*: 1962, 127. Also II/828.

593 Falk, R., Rahat, A., Ben-Zeev, N. VIABILITY OF HETEROZYGOTES FOR INDUCED MUTATIONS IN Drosophila melanogaster. I. IRRADIATED X-CHROMOSOME. Mutation Res. 2, 5 (1965) 438-51.

The mean viability of Drosophila flies carrying a wild type and a marked irradiated X-chromosome was studied. The viability of hemizygotes as well as that of heterozygotes for each irradiated chromosome was calculated. Irradiation of nearly 3000 R induced about as many severe detrimentals (semi-lethals and subvitals) as lethals. The viability of heterozygotes for the severe detrimentals was even worse than that of the heterozygotes for lethals. The dominance of lethals and severe detrimentals was 5% and 15% respectively. Within the normal range the viability of hemizygotes for irradiated chromosomes was reduced by about 2% and a similar reduction was observed in the heterozygotes for these chromosomes. This suggests complete dominance for the slight deleterious effects. The significance of this study in relation to fitness and population structure is discussed. (Auth. summary)

594 Friedman, L.D. x-RAY INDUCED SEX-LINKED LETHAL AND DETRIMENTAL MUTATIONS AND THEIR EFFECT ON THE VIABILITY OF Drosophila melanogaster. Genetics 49 (1964) 689-99.

Tests were made on 2520 irradiated X-chromosomes taken from Drosophila laboratory stocks of Basc and Canton-S strains. Estimates were made on the proportions of lethals and the genetic load of lethals and detrimentals induced. The Basc chromosome is about 50% more responsive to radio-induced lethal mutation than the Canton-S chromosome. It was found that the lethals induced in the + chromosome compared favourably with those tested by other workers, producing an average frequency of about 2.5%/1000 R. The ratio of the load due to detrimental mutants to that for lethals was 0.125. This is where the load is the product of the frequency and the average effect on viability. This is a considerably lower value than was obtained in earlier experiments but is in general agreement with a recent study by Käfer. Possible reasons for the different results are discussed. (Auth.)

595 Glass, H.B. THE ACTION OF RADIATION AND OTHER MUTAGENIC AGENTS (1) INDUCING MUTATION IN Drosophila FEMALES, AND (2) IN CONTROLLING THE ACTION OF SPECIFIC SUPPRESSOR GENES. p.104-6 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

596 Godfrey, R.K. A STUDY OF GENE AND CHROMOSOME CHANGES INDUCED BY IONIZING RADIATIONS IN Drosophila melanogaster. p.255 of "Research and Development in Progress. Biology and Medicine, No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

597(2) Hannah-Alava, A. RATES OF VISIBLE MUTATIONS AS RELATED TO THE MATURITY OF MALE GERM CELLS OF Drosophila melanogaster AT THE TIME OF RADIATION. TID-21459, Turku Univ. (Finland). Dept. of Genetics. 1961, 18p.

The effect of x-ray damage (measured by mutation rates at nine loci in the third chromosome, and dominants and Minutes in all chromosomes) on the male germ cells of D.melanogaster in different stages of maturity at the time of irradiation. It is based on the results from seven replicate experiments testing a total of 31 control males and 368 irradiated (3000 R) males mated sequentially at 2- or 3-d intervals for eight broods or until the male died. Each mutation type had a characteristic brood pattern of mutation rates. The lowest fertility, the lowest fecundity and the highest mutation rates except for the Minutes was in brood-3 (6-8 d after irradiation and the initial mating of the parental male). The average mutation rate for 9 third-chromosome loci was: 0.19% (7.02×10^{-8}/R/locus) in brood-1,1.17 (43.40) in brood-3, 0.08 (3.13) in brood-4, and 0.01 (0.26) in broods 5-8. A number of factors that could influence the brood pattern, e.g. age, viability and fertility of the male parent, genotype of the female parent and number of females were tested. Most were found to have an effect on the number of offspring/brood (particularly brood-1), but with the possible exception of number of females, the only detectable effect on the mutation rates appeared to be an increase in the variance.

598 Hannah-Alava, A. MUTATION RATES AT SPECIFIC AUTOSOMAL LOCI IN DIFFERENT SPECIES OF Drosophila. Final Report Covering Five Years, 1959-1964. TID-21601, Turku Univ. (Finland).Dept. of Genetics. 1964, 12p. IAEA 31/US, 12p.

Primary purpose of the work was to accumulate data on mutation frequencies of specific third-chromosome loci from cells in different stages of maturation at irradiation. Additional information was collected on spermatogonial mutation rates. Due to the experimental procedures used it was possible to obtain, in addition to the data on specific locus, frequencies for third-chromosome recessive lethals, dominant (visible) mutations and Minute mutations in all chromosomes. Male parents were exposed to a dose of 3000 R of x-rays. Cytomorphological studies of the testes were undertaken, also some isolated work on Drosophila simulans.

599 Hochman, B., Gloor, H., Green, M.M. ANALYSIS OF CHROMOSOME-4 IN Drosophila melanogaster. I. SPONTANEOUS AND x-RAY-INDUCED LETHALS. Genetica 35, 2 (1964) 109-26.

600 Ives, P.T. PATTERNS AND NATURE OF MUTAGENESIS INDUCED BY IONIZING RADIATION DURING SPERMATOGENESIS IN Drosophila. p.134 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

601 Kang, Y.S., Kim, Y.J., Lee, C.C., Choi, C.C. THE GENETIC STUDIES OF Drosophila POPULATION. 1. ON THE FREQUENCIES OF SEX-LINKED RECESSIVE LETHAL MUTATION IN D. melanogaster IRRADIATED WITH x-RAYS. Zoologica,Seoul 3 (1964) 1-6. (BAg 29: 1965, 101601). (In Japanese)

602 King, J.L. THE FORMATION OF DUMPY VORTICES IN MOSAICS OF Drosophila melanogaster. Genetics 49 (1964) 425-38.

Certain alleles of the gene dp produce vortices, which are changes in the configuration of the dorsal surface of the thorax and in the distribution of thoracic chaetae and hairs. The dp alleles appear to affect the chaeta pattern through tissue movement, since they do not change the total number of bristle organs. Cellular changes which occur are bristle organs with doubled chaetae, and small "bald" areas devoid of chaetae and cell hairs. The vortices are associated with insertions of certain of the indirect flight muscles through deep invaginations of the hypodermis and cuticle. Vortex formation begins prior to normal attachment of the flight muscles: the formation of vortices is indirectly responsible for the development of doubled chaetae. x-Ray induced somatic crossing over produced mosaic patches which were homozygous for dp and homozygous or hemizygous for yellow on a heterozygous wild-type background. Thirteen mosaics, including eight involving recessive lethal alleles, were recovered from an estimated 7 000 treated individuals. In the mosaic specimens, the dumpy recessives are non-autonomous: homozygous recessive patches bring about the vortex pattern in the adjacent heterozygous or homozygous dominant tissue, and, in three cases, in the heterozygous tissue of the opposite side of the thorax. The doubling of chaetae in the vortices is an indirect effect, since it sometimes occurs in the background tissue. The wild-type allele of dp, in response to specific developmental environments, appears to regulate (either directly or by intracellular inhibition) the production of a supracellular factor, which in turn affects tissue movement. The recessive alleles apparently fail to respond to these developmental environments, leading to a failure to regulate the production of the supracellular factor and thus to abnormal tissue movement. It is concluded that dp is not a prepattern gene with respect to the distribution of thoracic bristle organs, since it does not have any effect on the determination of bristle organ anlagen. The differentiation of doubled chaetae, however, is due to a physical change in the cellular environment, indirectly brought about by dp; in this minor respect dp can be considered a prepattern gene. (Auth.)

603 Kishin, A.F. RECESSION. THE EFFECT OF LEVEL OF FEEDING ON THE FREQUENCY OF x-RAY INDUCED SEX LINKED LETHAL IN D. melanogaster. Drosoph. Inf. Serv. 39 (1964) 101.

604 Kishin, A.F. "YANDERS EFFECT" – A RE-EXAMINATION. Am. Nat. 99 (1965) 89-96.

Recessive lethals, and Y; 2; 3 translocations were scored in four successive collections from F_1 cultures of x-rayed Or-K males. Results showed no constant increase in the frequency of either, from early to late emergers. Experiments in which rates of development of lethal and non-lethal heterozygotes were compared suggest that lethal heterozygotes may have a slightly slower rate. Yander's findings that the rate of recessive lethals increases in the late emergers from F_1 culture of a Muller-5 test may still apply under crowded conditions.

605 Kvelland, I., Strømnaes, Ø. x-RAY INDUCED MINUTES IN Drosophila melanogaster SPERM EJACULATED IN CONSECUTIVE MATINGS. Hereditas 54, 2 (1965) 170-76.

x-Ray (2000 R) induction of Minutes was studied in individual sperm ejaculates of males that were either 0-2 h, 24 h, or 72 h old at the time of irradiation. All males went through a 12-h mating period, then a 12-hperiod without females, and again a 12-h mating period. For all groups of males the frequency of Minutes was higher in the first than in the second mating period, although it reached statistical significance only between two particular series (24A and 24B). The difference in frequency of Minutes between age groups of males was significant when measured in the first mating period and not significant in the second mating period. The data supported Lüning's view that a change in mutation frequency does occur earlier after irradiation for sperm released by young but not older males. This may indicate sampling of sperm with different sensitivity at the time of irradiation. However, sequential numbers of ejaculates are also time-dependent; therefore, the data presented cannot exclude recovery with time coexisting with differential sensitivity. (Essentially auth. summary)

606 Lee, W.R. RADIATION INDUCED VIABILITY MUTATIONS IN THE HONEY BEE. p. 130-31 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

607 Magalhães, L.E. de, Toledo, J.S. de, Brito da Cunha, A. THE NATURE OF LETHALS IN Drosophila willistoni. Genetics 52, 3 (1965) 599-608.

The analysis of several natural and radiation induced lethal chromosomes was reported. A radiation dose of 800 R from a 50 Ci-^{137}Cs source was used. The same chromosome may behave either as though its lethality were due to a single locus, or as a synthetic lethal, depending upon which chromosome it is tested against. Synthetic lethals are lethal chromosomes produced by recombination between non-lethal chromosomes. Unilocal lethality or synthetic lethality are relative to the rest of the gene constellation, and are not absolute characters. A method is presented for analysing chromosomes with regard to the locations of lethality factors and their interrelations.

608 McSheehy, T.W. THE RELATIONSHIP BETWEEN RADIATION DOSE AND MUTATION FREQUENCY IN SPERMATOGONIA OF Drosophila melanogaster. Mutation Res. 1 (1964) 296-301.

Data are presented on the rate of induction of second chromosome recessive lethal mutations in D. melanogaster following irradiation of spermatogonia with ^{60}Co γ-rays over a dose range 200-800 rad. The dose-response was linear, the line of best fit being $y = 0.455 + 1.33 \times 10^{-3}\ x$. The data are discussed in relation to recently reported work on sex-linked recessive lethals. It was concluded that the linear dose-response reported in this paper resembled that observed at high radiation doses. Furthermore, these data were not incompatible with the non-linear response reported at low radiation doses. (Auth.)

609 Mukai, T., Yoshikawa, I., Chigusa, S. RADIATION-INDUCED MUTATIONS RATES OF POLYGENES CONTROLLING THE STERNOPLEURAL BRISTLE NUMBER IN Drosophila melanogaster. Rep. natn. Inst. Genet., Misima 14 (1964) 96-97.

610 Mukherjee, A.S., Stern, C. THE EFFECT OF SEXCOMBLESS IN GENETIC MOSAICS OF Drosophila melanogaster. Z. VererbLehre 96 (1965) 36-48.

Gynandric basitarsi possessing areas heterozygous for the sex-linked mutant sexcombless (sx) and hemizygous for it, and mosaic basitarsi possessing sx/+, sx/sx and +/+ areas have been studied for the developmental expression of sx and sx/sx patches in the sex comb region. The mosaic basitarsi were obtained as the result of somatic crossing-over following x-ray exposure of larvae. In order to observe the sex comb–forming potencies in these XX tissues the flies had been made homozygous for the gene tra which transforms females into phenotypic males. The development of sx/+; tra/tra females is greatly prolonged over that of normal females. Five of the 63 gynandric and two of the 39 radiation-induced mosaics showed a single typical tooth, a sixth gynandric basitarsus had two teeth. In all other cases intermediate bristles, or macrochaetae, or both, have been found in y sn sx hemizygous or homozygous patches irrespective of their seize. The sx-initiated distortion of bristle arrangement found in non-mosaic sx male basitarsi has also been seen in many mosaic patches. The mutant gene sx acts autonomously and interferes with the process of seta-cell to tooth determination at a relatively early stage in development of a bristle organ. (Auth. summary)

611 Muller, H.J. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila (1963-64). p. 137 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

612 Muller, H.J. THE INFLUENCE OF RADIATION IN ALTERING THE INCIDENCE OF MUTATIONS IN Drosophila. TID-22160, Indiana Univ. Foundation. Research Div., Bloomington, Ind. Aug. 1965, 8p.

Interim report.

613 Oak Ridge National Lab., Tenn. CYTOCHEMISTRY AND CELL REPRODUCTION. p. 64-9 of "Biology Division Semiannual Progress Report for the Period Ending February 15, 1965". ORNL-3768. May 1965, 205p.

A report is made on progress in various studies including work on visible mutation frequencies induced in Mormoniella oocytes by x-radiation, and the black eye colours of Mormoniella.

614 Oftedal, P. THE MUTAGENCIC EFFICIENCY OF ACUTE AND OF PROTRACTED IRRADIATIONS OF Drosophila SPERMATOGONIA. Hereditas 52, 2 (1964) 242. Abstr. Presented at the "3rd Meeting of the Scandinavian Association of Geneticists, Helsinki, Finland, 10-12 Jun. 1964".

A decreasing mutagenic efficiency for induction of sex-linked recessive lethals has been found for acute doses in the range 50 R - 300 R. The same doses protracted over 8 h (or 2-4 cell generations) appear to have a constant efficiency, which is about as high as the zero dose efficiency for acute treatments. Higher protracted doses are less efficient (400 R - 550 R). From the literature, it appears that doses an order of magnitude higher (3000 R - 12 000 R) have a constant efficiency, 4-5 times lower than the zero dose efficiency found here. It is proposed that the changes in mutagenic efficiency with dose and with dose rate may be explained by considering the killing of a small class of sensitive cells. These cells presumably represent a definite part of the mitotic cycle. (Abstr.)

615 Pavan, C. A COMPARATIVE STUDY BETWEEN NATURAL LETHALS AND LETHALS INDUCED BY RADIATION IN POPULATION OF Drosophila willistoni. p. 132-33 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

616 Puro, J.A. TEMPORAL DISTRIBUTION OF x-RAY INDUCED RECESSIVE LETHALS AND RECOMBINANTS IN THE POST-STERILE BROODS OF Drosophila melanogaster MALES. Mutation Res. 1 (1964) 268-78.

The distributions of third-chromosome recessive lethals and cross-overs were studied in daily post-sterile broods of D. melanogaster males treated as adults with 3000 R x-rays and mated singly and sequentially up to the 24th day or until the male became permanently sterile. Following the period of excessive sterility on the 6th-9th day, with a clear-cut sterile period on the 8th day, a marked increase in fecundity was found on the 10th day. The highest incidence of cross-overs was on the 10th day followed by a progressive decline in the later broods. The decrease in the frequency of lethals was not so evident, possibly because too few flies were tested in the latest broods. Despite the fact that clusters were to be expected, only singles were recovered from the 9th-10th day broods. Clusters were first found on the 11th day, but frequently not before the 12th day. Many clusters continued for several subsequent broods. It was concluded from continuing clusters that predefinitive gonia, through repeated "cambial"-like divisions, preserve the continuous supply of sperm. Thus continuing clusters can be used as a genetic criterion for differentiating between the definitive and predefinitive gonia. With the brood procedure used, treated definitive gonia were sampled on the 9th-11th day, and predefinitive gonia beginning from the 12th day. Hence the temporal pattern after the 12th day reflects the functional activity pattern of the stem cells. (Auth.)

617 Rasmuson, B. DISCRIMATION OF MUTANTS WITHIN THE ω-LOCUS OF *Drosophila melanogaster*. *Hereditas* *52*, 2 (1964) 244. Abstr. Presented at the "3rd Meeting of the Scandinavian Association of Geneticists, Helsinki, Finland, 10-12 Jun. 1964".

A method was outlined by which it should be possible to discriminate among different types of mutants in the ω-locus. The aim is the elucidation of the following problems concerning the fine structure of the ω-locus by the proposed scanning of mutations: (1) Frequency of coloured (leaky) mutants versus white (amorph) mutants; (2) frequency of male vital versus male lethal deficiencies; (3) the possible existence of lethal but non-deficient mutants; (4) how general the applicability is of point 3 among the interactions noted above, that deficiency of any site in the ω-locus acts as a suppressor of zeste. The result of a preliminary experiment using x-rays (5000 R) as inducer of mutations was reported. (From abstr.)

618 Roberts, P. MOSAICS INVOLVING ARISTAPEDIA, A HOMEOTIC MUTANT OF *Drosophila melanogaster*. *Genetics* *49*, 4 (1964) 593-8.

The mutant gene, aristapedia, transforms the arista of the antenna into a leg-like organ. Because of the drastic nature of the transformation it has been suggested that aristapedia alters a prepattern. In order to test this, genetic mosaics were produced by x-ray induced somatic crossing over. The autonomy of mutant and wild-type mosaic areas indicates that the alleles at this locus determine the competence of cells to respond to a prepattern rather than altering a prepattern. (Auth.)

619 Saul, G.B., 2nd, Whiting, P.W., Saul, S.W., Heidner, C.A. WILD-TYPE AND MUTANT STOCKS OF *Mormoniella*. *Genetics* *52*, 5 (1965) 1317-27.

The National Science Foundation stock centre at Dartmouth College contains most of the known wild-type and mutant stocks of *M. vitripennis*. The stocks are described and listed, and a preliminary indication of their association in linkage groups is provided. Some mutant stocks were the result of irradiation.

620 Sävhagen, R. RADIOSENSITIVITY OF SPERMATOGONIA. *Hereditas* *52*, 2 (1964) 243. Abstr. Presented at the "3rd Meeting of the Scandinavian Association of Geneticists, Helsinki, Finland, 10-12 Jun. 1964".

Larvae from a Canton-S wild type stock were irradiated with 900 R x-rays. The age of the larvae at the time of treatment were 0-1 h, 4-5 h and 24-25 h, calculated from the time of hatching. At the time of ecclosion the males (P males) were immediately separated from the females and mated individually to 3-4 virgin M5, *cn bw*; e^{11} females. Every 3rd day the males were transferred to new virgin M5, *cn bw*; e^{11} females for five consecutive 3-day mating periods (A, B, C, D and E). By use of the double-purpose stock (M5, *cn bw*; e^{11}) it was possible to detect in F$_2$ both induced sex-linked recessive lethals and II-III translocations. The offspring from mating periods C and D were not recorded. From the results it is evident, that the induction of translocations has not been confirmed for 1- and 5-h-old larvae respectively, whereas for 25-h-old larvae a few translocations are observed. Recessive lethals are observed in all mating periods. In the first mating period (A) a statistically significant difference is observed between the three larval groups (0.76%; 0.22%; 0.07%), while for mating period B and E no difference is observed between the larval groups. However for 25-h-old larvae there is also observed a statistically significant decrease in the number of observed recessive lethals in mating periods A (0.76%)-B (0.38%)-E (0.06%). This reduction in the number of observed recessive lethals parallels fairly well the observed difference in mating period A between 1, 5 and 25-h-old larvae. (Abstr.)

621(2) Shiomi, T., Inagaki, E. et al. MUTATION RATES AT LOW DOSE LEVEL IN *Drosophila melanogaster*. *J. Radiat. Res.* *4*, 2-4 (1963) 105-10.

The problem of genetic effects from low dose level radiation is a very important one. We have tested the linear relationship between dose and mutation rates of *Drosophila* at doses as low as 8 R. The material used was the wild Canton-S strain which were isogenized every 4 months. Wild males were stocked for 1 week after their emergence, and irradiated with x-rays. Sex-linked recessive lethals were detected by M-5 method, and about 53 000 X-chromosomes including the control were examined. The straight line obtained at the high dose level was in good accord with that obtained by Spencer and Stern (1948). And the curve obtained at high dose level was found to be applicable at the low dose level as well. Among the 26 897 males treated, there were 25 cases which produced 2-15 lethals. How to treat the simultaneous occurrence of two or more lethals in a set of 20 tested chromosomes originated from one treated male is an important and troublesome problem. However, sufficient evidence is available to conclude that the linear relationship between mutation rates and radiation dose can be applied to low doses down to 8 R by using the sex-linked recessive lethal mutations in *Drosophila*, one of the most reliable indicators of mutation induction. (Auth.)

622 Stern, C. RADIATION AND MUTATION RATE. p. 140 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

623(2) Stevens, J.M., Le Roux, P.R. THE INDUCTION OF CONTINUOUS VARIATION BY x IRRADIATION IN *Drosophila*. p. 505-13 of "National Conference on Nuclear Energy. Application of Isotopes and Radiation". Atomic Energy Board, Pelindaba, South Africa. 1963.

The induction of continuous variation in sternopleural and abdominal chaetae number consequential to the irradiation of chromosome II of *D. melanogaster* was studied. Using an isogenic line that was obtained by the usual technique from an inbred line, two irradiation series, 500 and 1000 R were started. Each series comprised 25 lines characterized by having one specific chromosome II. The chromosome was kept exclusively in the male line and balanced against the CyL^4 inversion. It was thus protected from recombination and to a large extent from the action of natural selection. Males were irradiated and mated to CyL^4/Pm females having a homogeneous genetic background that was constantly renewed by a series of matings involving back-crossing to the isogenic line. After each irradiation the pairing affinity and lethality of the irradiated chromosome were tested. Only lethal-free chromosomes that did not impair fertility were kept. Mutations were thus allowed to accumulate in chromosome II and after every third or fourth generation of irradiation an assessment of the amount of variation produced in chaetae number was made by using a modified version of the diallel technique. In the 500 R series variation was detected in the number of abdominal chaetae at a dose of 3000 R and in sternopleural number at 4500 R. In the 1000 R series sternopleurals and abdominals responded at 9000 and 12 000 R respectively. About one third of the induced phenotypic variation is heritable in the narrow sense and could thus be utilized by selection. The additive variation increased linearly with dose and it was estimated that the additive variance increment per roentgen was $(1.6 \pm 0.2)\,10^{-5}$ and $(3.7 \pm 1.4)\,10^{-5}$ for sternopleurals and abdominals, respectively. These values are considerably lower than those obtained by others but estimates are free from chromosomal and genic recombination effects. (Auth.)

624(1) Tazima, Y., Onimaru, K. NATURE OF RADIATION INDUCED MUTATIONS DETECTED IN THE SILKWORM BY THE METHOD OF SPECIFIC LOCI. *Rep. natn. Inst. Genet.*, Misima *10* (1959) 115-16.

625 Tokunaga, C., Stern, C. THE DEVELOPMENTAL AUTONOMY OF EXTRA SEX COMBS IN *Drosophila melanogaster*. p. 1-25 of "Semiannual Report – Biology and Medicine, Fall 1964". Lawrence, J.H., Ed. UCRL-11833, Lawrence Radiation Lab., Univ. of California, Berkeley, 163p.

For subsequent publication and abstract, see 626.

626 Tokunaga, C., Stern, C. THE DEVELOPMENTAL AUTONOMY OF EXTRA SEXCOMBS IN Drosophila melanogaster. Devl Biol. 11 (1965) 50-81.

In male flies the first legs possess a sex comb, tibial transverse rows of bristles, and basitarsal transverse rows. These structures are absent on the second and third legs. The recessive autosomal mutant esc (extra sex comb) transforms certain features of the second and third into those of first legs. In different legs the transformation may be incomplete. The different parts may be transformed independently of each other, resulting in an array of partially transformed legs which are epigenetic mosaics of changed and unchanged areas. Genetic mosaics consisting of esc/esc patches on esc/+ legs were obtained in consequence of x-ray induced somatic crossing over. The age of larvae during irradiation varied from 27 to 120 h. The x-ray dosage varied from 700 R to 2400 R with a dose rate of about 80 R/min, the youngest larvae receiving the lower dosages. Some prepupae aged 120 to 130 h were also irradiated, with from 2100 R to 2400 R. By a translocation the esc/esc areas were marked by genetically yellow pigmentation on the background of wild-type esc/+. In the genetic mosaics esc acts autonomously in causing the appearance of sex combs and both types of transverse rows even in very small esc/esc areas. Wild-type colored sex comb teeth on second and third legs were induced by x-irradiation of esc/+ males. The second legs of males with the combination $esc^{D}en/+en$ of esc^{D}, a dominant allele of esc, and en (engrailed) had a typical (primary) sex comb as well as the secondary comb normally placed by en on the first leg only. The gene esc as compared to esc+ controls the terminal pattern of leg differentiation by changing the competence of imaginal disk cells to respond to a prepattern that is alike for both alleles. The changed response consists in a tendency in certain areas toward growth in a transverse direction coupled with differentiation in a closely packed row, of bristles or teeth. (Essentially auth. summary)

627 Trout, W.E. DIFFERENTIAL RADIOSENSITIVITY AS AN EXPLANATION FOR SO-CALLED RECOVERY IN Drosophila SPERM. Genetics 50 (1964) 173-9.

A decline in the sex-linked lethal mutation frequency from the first to the second day after x-irradiation was observed with rod- and ring-X chromosomes of D. melanogaster when males, irradiated 3-4 d after eclosion, were mated singly to females at either half-day or daily intervals. A rise in frequency was observed, however, if males had been exhaustively mated for 8 d after eclosion and were then irradiated. In all cases an intermediate mutation frequency was observed if males were not allowed to mate on the first day. On the other hand, the frequency for the second day for males which on the first day were given the opportunity to mate, but failed to do so effectively, was even lower than the second day frequency for males that mated on the first day. All these results support the concept of a differential sensitivity to x-rays associated with position in the genital tract, and mixing of sperm if matings are delayed, rather than a recovery process. (Auth.)

628 Whiting, A.R. THE COMPLEX LOCUS R IN Mormoniella vitripennis (Walker). p.341-58 of "Advances in Genetics. Vol.13". Caspari, E.W., Thoday, J.M., Eds. New York, Academic Press. 1965, 378p.

Review article. A number of eye-colour changes had been x-ray induced.

629 Whiting, P.W., Ray, D.T. VISIBLE MUTATION FREQUENCIES INDUCED IN Mormoniella OOCYTES BY x RADIATION. p.65-66 of "Biology Division Semiannual Progress Report for the Period Ending February 15, 1965". ORNL-3768, Oak Ridge National Lab., Tenn. May 1965, 205p.

A summary is presented of earlier studies on the mutation frequencies induced in oocytes exposed to doses between 1136 and 5680 R, and of data collected from wasps irradiated with lower exposures (52.5 - 525 R). From the age of the females irradiated results were expected to represent mutations induced in oocytes in the first meiotic prophase stage of development. The higher dose data indicate that visible mutations are induced by more than one event (slope nearly 2), whereas the lower-dose portion of the curve indicates that, even when the data are corrected for spontaneous mutations the slope is still < 1.

630 World Health Organization, Geneva (Switzerland). GENETICS OF VECTORS AND INSECTICIDE RESISTANCE. Wld Hlth Org. tech. Rep. Ser. 268 (1964) 40p.

About ten useful markers have been isolated in Culex pipiens pipiens and in Culex pipiens fatigans. All three linkage groups have been distinguished. There is an evident tendency of the same mutant to occur in independent stocks. Thus scale-row, four-jointed palpi, R_2 (a wing-vein mutant), and kps and kpu (both palpal mutants) have occurred independently in both molestus and in fatigans. Most of these mutants have been recovered after x-irradiation. – In the course of x-ray experiments several anomalies in wing-vein pattern, tarsal shape and antennal form have been recovered from A. quadrimaculatus. None of these have yet been isolated.

631 Yanders, A.F. A RELATIONSHIP BETWEEN SEX RATIO AND PATERNAL AGE IN Drosophila. Genetics 51 (1965) 481-6.

D. melanogaster males aged 1, 7, or 14 d were mated at 24-h intervals to pairs of virgin females and transferred to new females at 24-h intervals for eight mating periods. The sex ratio of their progeny showed a trend toward a greater proportion of females, which was related to the age of the parent male at the time of mating. Irradiation of the males reduced the proportion of their female progeny, but the shift in sex ratio showed the same relationship to paternal age as in the untreated groups. An age-related, non-random meiotic segregation of sex chromosomes into functional and nonfunctional sperm provides a satisfactory explanation for these results. (Auth.)

See also:

14 Nonrandom distribution of lethals induced by tritiated thymidine in Drosophila melanogaster. (Kaplan, W.D. et al., 1964)
15 The distribution of sex-linked recessive lethals induced in Drosophila males by tritiated deoxycytidine. (Kaplan, W.D. et al., 1965)
21 On the mutagenic effectiveness of incorporated ^{14}C. (Kuzin, A.M. et al., 1964)
22 Mutagenic effect on mature Drosophila spermatozoa of P^{32} incorporated into DNA. (Lee, W.R. et al., 1965)
23 The mutagenic effect of tritiated uridine in Drosophila spermatocytes. (Olivieri, G., Olivieri, A., 1965)
24 Genetic effect of incorporated ^{14}C in Drosophila melanogaster. (Purdom, C.E., 1965)
26 The relative mutabilities of DNA in regions of the X-chromosome of Drosophila melanogaster. (Rudkin, G.T., 1965)
27 Mutations in Drosophila melanogaster grown on media containing carbon-14 labelled sugars. (Suomalainen, E. et al., 1956)
35 Localization, persistence and resultant genetic effect in invertebrates of ingested fourth period metals in stable and radioactive forms. (Grosch, D.S., 1964)
524 Basic fertilization phenomena and gametic lethality in Drosophila. (Yanders, A.F., 1964)
532 Radiosensitivity of the stages of spermatogenesis to different mutations in Drosophila melanogaster. (Fahmy, O.G., Fahmy, M.J., 1964)
536 The mutability of mature sperm of Drosophila melanogaster irradiated in the female and in the male. (Lefevre, G., Jr., 1965)
537 x-ray induced mutability in male germ cells of Drosophila melanogster. (Lefevre, G., Jr., Jonsson, U.-B., 1964)
544 Drosophila cytology and genetics. (Oak Ridge National Lab., Tenn., 1964)
545 Radiosensitivity of Drosophila spermatogonia. II.Protracted doses. (Oftedal, P., 1964)
546 The radiosensitivity of Drosophila spermatogonia. I. Acute doses. (Oftedal, P., 1964)
562 The brood-pattern of x-ray-induced mutational damage in the germ cells of Drosophila melanogaster males. (Hannah-Alava, A., 1964)
563 The brood-patterns of mutations and crossing-over recombinants in successive broods of F_1 offspring from males treated with 3000 R of x-rays. Period covered: Nov.1, 1959 - Oct.31, 1964. (Hannah-Alava, A., 1964)
568
569 Drosophila cytology and genetics. (Oak Ridge National Lab., Tenn., 1964)
581 Non-divergence of chromosomes under the influence of x-rays of varied hardness and intensity. (Tikhomirova, M.M., 1964)
584 Dependence of frequency of occurrence of phenocopies on x-ray dose. (Volchkov, Yu.A., Aleksandrov, Yu.N., 1963)
589 Radiation induced deletions in spermatids and spermatocytes of Drosophila. (Zimmering, S., Kirshenbaum, G., 1964)

664 Change in the nature of radiation-induced mutation in the spermatids of *Drosophila* under the influence of arginine. (Abeleva, E.A., 1964)

665 Lethals in *Drosophila* spermatogonia after fractionated x-irradiation. (Baxter, R.C., 1964)

667 Genetic effect of combined x-ray and ethylenimine treatments. (Alexander, M.L., 1965)

669 Combined ICR 100 and x-ray analysis of the strandedness of the spermatozoan of *Drosophila melanogaster.* (Carlson, E.A., Novitski, E., 1964)

672 Genetic effect of small doses of ionizing radiation. (Dubinin, N.P. et al., 1964)

674 x-ray damage as measured by dominant lethals, sex-linked recessive lethals and translocations in *Drosophila melanogaster* and oxygen and argon as its modifying factors. (Elequin, F.T., 1965)

680 The influence of cosmic flight factors on the frequency of sex-lined recessive lethal mutations in *Drosophila melanogaster.* (Glembotskiĭ, Ya.L. et al., 1963)

681 Comparative studies of mutation frequencies induced by ^{32}P treatment and γ-irradiation in the male silkworm. (Ikenaga, M., Kondo, S., 1965)

682 The comparative pattern of mutagenesis in *Drosophila* spermatogenesis after x rays vs Co^{60} gamma radiation. (Ives, P.T., 1964)

684 Mutagenic effect of irradiated and unirradiated DNA in *Drosophila.* (Khan, A.H., Alderson, T., 1965)

685 Effects of storing x-rayed spermatozoa on the frequency of translocations and sex-linked lethals in *Drosophila melanogaster.* (Khishin, A.F.E., 1963)

688 Effect of 5-hydroxytryptamine (serotonin) on the radiation-induced rate of mutation in *Drosophila melanogaster.* (Künkel, H.A. et al., 1965)

690 The effect of mating intensity on mutation frequency patterns detected after irradiation of *Drosophila melanogaster* males. (Lefevre, G., Jr., Jonsson, U.-B., 1964)

691 Factors modifying mutation frequency patterns detected after irradiation of *Drosophila melanogaster* males. (Lefevre, G., Jr., 1965)

692 Study on the effect of catalase and peroxydase on radiation-induced mutability in *Drosophila melanogaster.* (Magdon, E., Winterfeld, G., 1965)

693 On the fractional- and whole-body mutations induced by soft x-rays in *Drosophila.* (Matsudaira, Y. et al., 1964)

694 The failure of sulphhydryl compounds, AET, MEA, and glutatione to protect against x-ray induced chromosome aberrations in male *Drosophila.* (Mittler, S., 1964)

699 Comparative studies of mutation frequencies induced by ^{32}P treatment and γ-irradiation in the male silkworm. (Mituo, I., Kondo, S., 1965)

700 Actinomycin D effects on the frequency of radiation-induced mutations in *Drosophila.* (Mukherjee, R., 1965)

701 Relative biological effectiveness of 14 MeV neutrons to γ-rays for inducing mutations in silkworm gonia. (Murakami, A., Kondo, S., 1964)

702 Comparison of fission neutrons and γ-rays in respect to their efficiency in inducing mutations in silkworm gonia. (Murakami, A. et al., 1965)

703 Modification of x-rays induced mutation rate in the silkworm by pre or post irradiation treatment with halogenated bases analogues. (Murakami, A., Tazima, Y., 1962)

705 Further data on the interaction between ultraviolet and ionizing radiations on the production of recessive lethals in *Drosophila melanogaster.* (Nicoletti, B. et al., 1964)

707 Modification of genetic damage produced by ionizing radiation. (Oster, I.I., 1964)

710 Induction of sex-linked recessive lethals and visible mutations by feeding x-irradiated DNA to *Drosophila melanogaster.* (Parkash, O., 1965)

711 On the radiomimetic effect of irradiated desoxyribonucleic acid (DNA$_{m}$) on *Drosophila melanogaster.* (Parkash, O., 1965)

712 Genetic effects of fast neutrons from nuclear detonations. Projects 23.4-2314 and 23.16 of operation upshot-knothole. (Plough, H.H., Ed., Sheppard, C.W., Ed., 1954)

713 Effect of sulphydryl reagents on the frequency of x-ray-induced autosomal recessive lethal mutations in *Drosophila melanogaster.* (Purdom, C.E., Bridges, B.A., 1964)

714 Lack of mutagenic effect of irradiated *Drosophila* medium. (Reddi, O.S. et al., 1965)

715 Genetic effects of cosmic radiation in *Drosophila melanogaster.* (Reddi, O.S., Sanjeeva Rao, M., 1964)

718 Effect of cold treatment post-irradiation on the loss of Seta dorso-centralis anterior in *Drosophila melanogaster* Sevelen and Berlin inbred. (Schleuss, P., 1964)

721 The effect of post-treatment with N_2 or O_2 on the frequencies of recessive lethals and translocations produced by irradiation in N_2 or O_2. (Sobels, F.H., 1963)

722 Post-radiation reduction of genetic damage in mature *Drosophila* sperm by nitrogen. (Sobels, F.H., 1964)

723 The role of oxygen in determining initial radiosensitivity and post-radiation recovery in the successive stages of *Drosophila* spermatogenesis. (Sobels, F.H., 1965)

724 The effect of temperature during irradiation on induced mutation frequency in *Drosophila melanogaster* sperm. (Sollunn, F.J., Strømnaes, Ø., 1964)

728 Independence of induced mutation-rate from radiation dose rate in the germ cells of hibernating silkworm embryo. (Tazima, Y., Onimaru, K., 1963)

729 Enhancement of radiation induced mutation frequency by post treatment of silkworm gonia with 5 bromodeoxyuridine. (Tazima, Y., Murakami, A., 1963)

730 Contribution from 14 MeV neutron experiments to the interpretation of the mechanisms of dose-rate effects on mutation frequency in silkworm gonia. (Tazima, Y., 1965)

731 Mechanisms controlling two types of dose-rate dependence of radiation-induced mutation frequencies in silkworm gonia. (Tazima, Y., 1965)

732 The increase in induced mutation frequency after fractionated irradiation of gonial cells of the silkworm. (Tazima, Y., Murakami, A., 1962)

733 Further report in the increase of induced mutation frequency after fractionated irradiation of gonial cells of the silkworm. (Tazima, Y., Onimaru, K., 1963)

734 Analysis of postirradiation modification of genetic damage in mature *Drosophila melanogaster* sperm. (Trosko, J.E., 1964)

735 Effect on genetic damage of post treatment given x-rayed *Drosophila* males. (Trosko, J.E., 1964)

736 Induced mutation process – *I* the effect of high temperature after irradiation on the frequency of occurrence of lethal mutations and chromosomal breaks. (Vatti, K.V., Yanoosh, I.M., 1964)

738 The rate of gonadal mosaicism for lethals in late broods of *Drosophila* as compared with early when induced by x-rays, azaserine and quinacrine mustard. (Altenburg, E., Browning, L.S., 1964)

741 Somatic mutations in the moth *Ephestia.* (Caspari, E.W., 1964)

742 Effects of DNA base analogues on the scales of the wing of *Ephestia.* (Caspari, E.W. et al., 1965)

744 Mutagenesis in relation to genetic hazards in man. (Fahmy, O.G., Fahmy, M.F., 1964)

745 Induction of lethal mutations in *Drosophila melanogaster* by DNA. (Gershenson, S., 1965)

746 On the mutagenic effects of x-radiation, *N*-nitroso-*N*-methyl-urethan, and *N*-nitrosomorpholine in *Drosophila melanogaster.* (Henke, H. et al., 1963/64)

747 The differential mutation effect of certain carcinogens. (Henke, H. et al., 1965)

751 Mutations induced by alkylating agents, x-rays and combined treatments. (Mazar-Barnett, B.K. de)

753 Mutagenic action of mitomycin C on *Drosophila melanogaster.* (Mukherjee, R., 1965)

755 Comparisons between mutagenic and cell-killing effects induced by radiation and radiation and radiomimetic substances. (Nakao, Y., 1965)

757 A comparison of genetic changes induced by a monofunctional and a polyfunctional alkylating agent in *Drosophila melanogaster.* (Snyder, L.A., Oster, I.I., 1964)

766 Effects of gamma radiation on the fertility of the two-spotted spider mite and its progeny. (Henneberry, T.J., 1964)

805 Radiosensitivity of female germ cell stages of *Dahlbominus.* (Baldwin, W.F., 1965)

835 Effects of low-level gamma-radiation on the immature stages of *Dahlbominus fuscipennis* (Zett.) (Hymenoptera: Eulophidae). (Riordan, D.F., 1964)

926 Genetic loads in irradiated experimental populations of *Drosophila melanogaster.* (Sankaranarayanan, K., 1964)

934 During several generations irradiated spermatogonia in *Drosophila melanogaster.* A population analysis. (Eiche, A., 1964)

935 On lethals and their suppressors in experimental populations of *Drosophila willistoni.* (Magalhães, L.E. de, et al., 1965)

939 Heterozygous effects of radiation-induced mutations on viability in homozygous and heterozygous genetic background in *Drosophila melanogaster.* (Mukai, T., Yoshikawa, U., 1964)

945 Inheritance of quantitative characteristics and methods for increasing the genetic mutability of populations. (Scossiroli, R.E., 1963)

946 Research in genetics to include (1) the direct and indirect effects of radiations and their

modification on genetic systems, and (2) population and evolutionary studies of Drosophila. (Stone, W.S., 1964)

947 Genetic effects of x rays on quantitative characters in a heterogeneous population of Drosophila melanogaster. (Tobari, I., Nei, M., 1965)

949 Genetic variability in Aedes aegypti (Diptera: Culicidae). III. Plasticity in laboratory populations. (Vandehey, R.C., 1964)

6. Dominant Lethality. Sterility. Cell Killing

632 Anonymous. HOW FAR A FLY CAN FLY. Agric. Res., Wash. 13, 12 (1965) 5.

Sterilization by means of irradiation was studied on Lucilia the blowfly. Using colour tags, a dispersion of up to 300 miles was traced. The practical significance for control measures of determining the limits of an infested zone is stressed.

633 Atwal, A. S., Sethi, S. L. EFFECT OF GAMMA RADIATION ON THE STERILIZATION OF Corcyra cephalonica Stanton (LEP.: PYRALIDIDAE). p. 6-7 in "Information Circular on Radiation Techniques and their Application to Insect Pests, No. 4". WP/31/4, International Atomic Energy Agency. Apr. 1964.

634(2) Drummond, R. O. EFFECTS OF GAMMA RADIATION ON THE FERTILITY OF THE COMMON CATTLE GRUB, Hypoderma lineatum (De Villers). Int. J. Radiat. Biol. 7 (1963) 491-5.

At 9-13 d after collection from the backs of cattle as larvae, or 6-8 d before heel flies emerged, pupae of the common cattle grub, H. lineatum (de Villers), were exposed to 1000, 2500, 5000, or 7500 R of γ radiation from a ^{60}Co-source. Flies from irradiated pupae were mated with those from non-irradiated pupae to determine fertility of the treated individuals. At 5000 and 7500 R both sexes were completely sterilized; at 2500 R females were completely sterilized and males exhibited reduced fertility.

635 Elbadry, E. SUPPRESSION OF THE REPRODUCTIVE POTENTIAL OF THE POTATO TUBERWORM, Gnorimoschema operculella BY GAMMA IRRADIATION. J. econ. Ent. 57, 3 (1964) 414-5.

The use of sterile females rather than of sterile males for control measures appears more promising since the sterile males were unable to compete satisfactorily with normal ones. Minimum sterilizing doses of γ-radiation for male and female pupae were 15 000 and 18 000 rad, respectively, at a dosage of 180 000 - 196 000 rad/h, from a ^{60}Co-source.

636 Erdman, H. E. DOMINANT LETHAL PROPORTIONS MODIFIED BY x-RADIATION, TEMPERATURES, AND COHABITATION IN SINGLE- AND MIXED-SPECIES POPULATIONS OF FLOUR BEETLES, Tribolium confusum AND T. castaneum. Radiat. Res. 22, 1 (1964) 187. Abstr. 59.

Virgin 3-week-old adult Tribolium were given 0, 1575, and 2625 R of x-rays. Single-species populations (10 pairs per 20 g food) and mixed species populations (5 pairs each species per 20 g food) were kept at 25, 29, and 32℃ and 65-70% relative humidity. Each 2 weeks, for 10 weeks, parents were supplied fresh food. Used food was reincubated whence adult F_1 were segretated as to species and counted. To assess radiation damage on the productivity in flour beetles, the proportions of induced dominant lethals, which in mixed species populations include lethals associated with coexistence, were calculated from the number of live adult F_1. This method accounts for genetic, zygotic, larval and pupal lethality inclusively. Early-life (egg and young larval stages) lethality of the F_1 was estimated by subtracting observed larval-pupal deaths from calculated dominant lethal deaths. Statistical analyses of the data indicated that the frequency of dominant lethals induced by x-radiation increased with progressively higher exposures, but temperature and cohabitation influenced this frequency within a species. Cohabitation was responsible for some increase in lethality, but again temperature and x-ray exposure influenced the expression. Radiation alteration of productivity and induction of dominant lethals were influenced by x-ray dose temperature, species and cohabitation. In conclusion, for both species x-ray-induced dominant lethality in the F_1 occurred predominantly during early-life. The incidence of this lethality throughout the life cycle was greater for T. confusum than for T. castaneum. (Abstr.)

637 Flint, H. M. THE EFFECT OF COBALT 60 GAMMA RAYS ON THE BIOLOGY OF THE EYE GNAT, Hippelates pusio Loew. Diss. Abstr. 25, 7 (1965) 3803.

The effects of irradiation on the life processes of the gnat were studied, with a view to the possible application of the "sterile-male" technique for its eradication. Dose rate used was approximately 2500 R per min. Test insects were maintained at 80° ± 2°F and approximately 70% relative humidity. Fertility was assayed by egg hatch. Insects were considered to be sterile when egg hatch was reduced to ≤ 1%. Sterility tests were made on gnats treated as 24- to 36-h-old adults and pupae treated 2 d prior to emergence. The sterilizing dose for males treated as adults was 4550 R and for males treated as pupae the sterilizing dose was 3750 R. Females required 4900 R when treated as adults and 4700 R when treated as pupae. Males were found to compete normally with untreated males for fertilization of females when the males were sterilized in the adult stage. Males sterilized in the pupal stage were much less effective in competing for females. A partial recovery of fertility was observed in males 18 d after treatment when treated with 4500 R as pupae and up to 3000 R when treated as adults. Female gnats which had been treated in the pupal stage with the sterilizing dose did not lay eggs in the adult stage. However, egg production from females treated in the adult stage was approximately 2/3 that of control gnats. In mortality tests, adults were treated with doses as high as 135 000 R which caused death within 4 d. A dose of 5000 R showed no effect on the life span of treated adults during a 7 week test period. Pupae were found to be more sensitive to irradiation than adults. Emergence was prevented in half the treated pupae by a dose of 12 000 R. Last-instar-larvae were very susceptible to a dose of 3500 R as measured by adult emergence. Eggs which were only a few hours old were sensitive to doses as low as 100 R but within 48 h were able to withstand several thousand R. An examination of the morphology of ovaries from gnats treated as pupae revealed that growth was inhibited by doses as low as 500 R. The ovary was unable to develop any adult structure after a dose of 4500 R. Testes from gnats treated as pupae with 4500 R were retarded in growth but produced motile sperm. Cytological examination of treated testes revealed visible chromosomal abnormalities in pupae and adults treated with 2500 R. The diploid (2N) chromosome number from untreated larval brain tissues was found to be 8. (From DA)

638(2) Frizzi, G. STRUTTURE CROMOSOMICHE SALIVARI E LORO CONTRIBUTO AL PROBLEMA EVOLUTIVO. (Structures of salivary chromosomes and their contribution to the problem of evolution). Rc. Semin. Fac. Sci. Univ. Cagliari 31 (1961) 1-. (In Italian)

Anopheles atroparvus were irradiated with dosages of 2000 R - 6000 R. The latter dose gave complete sterility but 3500 R produced the highest rate of chromosomal mutations. Both pericentric and paracentric inversions were most frequently found deficiencies and rarely translocations. Most of the inversions were in chromosomes II and III, very few in X.

639 Gomez-Numez, J. C., Gross, A., Machado, C. GAMMA RADIATION AND THE REPRODUCTIVE BEHAVIOR OF MALE Rhodnius prolixus. Acta cient. venez. 15 (1964) 97-104. (In Spanish)

In view of the fact that R. prolixus is the principal vector of Chagas disease, a serious disease in regions of Latin America, radio-sterilization of the male insects was investigated since this technique has been used successfully in eradicating or eliminating other insect vectors of disease. The effects of 2500 R to 40 000 R doses of ^{60}Co γ-rays were compared with earlier results obtained with x-rays on the male insects. Fertility was reduced to 74.4% of normal after 2500 R. Fertility decreased with higher doses until only 0.3% fertility resulted at 20 000 R. Males exposed to 40 000 R were completely sterile and unable to mate because of radiation damage. Spermatogenesis was more susceptible to radiation than the mature sperm, so that sterility increased with time and mating frequency through the replacement of old sperm cells by new ones. Irradiated males mated more frequently than untreated ones and, as mating stimulates oviposition, the quantity of eggs layed by the females enclosed with them also increased. It was shown that 5000 R or less do not hinder the insect's mating ability, at least within a limited initial time period. For an equal degree of sterility, γ-radiation shows certain advantages over x-rays only when the dose does not exceed 7500 R; above this dose x-rays cause less change to the male's reproductive behaviour. Although 5000 R improved the male's mating capabilities for at least 9 weeks after irradiation, it did not produce the desired sterility. This is only obtainable with doses above the limit where mating-inhibiting damage appears. It is concluded that the sterile male technique is not applicable to R. prolixus. (From NSA 19:1965, 25914)

640 Hoenigsberg, H. F. NON LINEARITY IN DOMINANT LETHALS INDUCED WITH IRRADIATION IN Drosophila melanogaster. Caldasia 9, 42 (1964) 129-136.

641 Jefferies, D. J. SUSCEPTIBILITY OF THE SAW-TOOTHED GRAIN BEETLE, Oryzaephilus surinamensis (L.) TO GAMMA RADIATION.[*] p. 119-30 of "Entomology of Radiation Disinfestation of Grain". Cornwell, P. B., Ed. Oxford, Pergamon Press. 1966[**], 236p.

The saw-toothed grain beetle, O. surinamensis, is more resistant to γ-radiation than S. granarius; 15 300 rad is required for 99·9 % sterility of adults and calculations show that at 30°C, the sterilizing dose for weevils (16 000 rad) controls O. surinamensis for a period of 8-12 weeks. The efficacy of this dose under conditions likely to be experienced in commercial practice is discussed. (From auth.)

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[*] For an earlier report of the same title, AERE-R-3891, see II/1261.

[**] Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U. K. A. E. A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

642 LaChance, L. E., Riemann, J. G. CYTOGENETIC INVESTIGATIONS ON RADIATION AND CHEMICALLY INDUCED DOMINANT LETHAL MUTATIONS IN OOCYTES AND SPERM OF THE SCREWWORM FLY. Mutation Res. 1, 3 (1964) 318-33.

Adult female Callitroga hominivorax containing oocytes in early prophase or early anaphase of the first meiotic division, and day-old males containing mature sperm were exposed to doses of γ-radiation or the alkylating agent, 2, 4, 6-tris(1-aziridinyl)-s-triazine (I) sufficient to induce 100% dominant lethals. These were characterized by chromosome bridges and fragments between dividing nuclei in the embryo, evident during the first and second meiotic divisions after γ-irradiation and persisting until development ceased during early cleavage. After treatment with I, these changes were detected only during cleavage divisions or after one replication of chromatin. (CA 62:1965, 2024h)

643 LaChance, L. E., Crystal, M. M. INTRODUCTION OF DOMINANT LETHAL MUTATIONS IN INSECT OOCYTES AND SPERM BY GAMMA RAYS AND AN ALKYLATING AGENT: DOSE-RESPONSE AND JOINT ACTION STUDIES. Genetics 51 (1965) 699-708.

Adult female screw-worm flies containing oocytes in early prophase or early anaphase of the first meiotic division, and 1-d-old males containing mature sperm were exposed to graded doses of γ-radiation or the alkylating agent, 2, 4, 6-tris(1-aziridinyl)-s-triazine (=tretamine). Frequency of dominant lethal mutations induced by these treatments was determined by scoring hatchability of eggs produced by inseminated females. Crosses involved treated females × untreated males or the reverse. Dose-response curves permit a comparison of radiation and tretamine treatments on the three stages of reproductive cells that differ greatly in their sensitivity to both radiation and chemical mutagens. Shapes of curves for both radiation and tretamine treatments are remarkably similar for the same cell stage. The relationship between dose and percentage of dominant lethals was non-linear for all cell stages. In testing for possible potentiation of one treatment by the other when treatments were applied consecutively, adult males and females were exposed to tretamine followed in 16 min by a exposure to γ-radiation. Doses used were known to produce less than 50% dominant lethals when given alone. Treated insects were crossed to untreated ones and frequency of dominant lethal mutations induced by combined treatments compared with those by single treatments was assessed. Results indicated that the effect of combined treatments on oocytes and sperm was merely additive, at best. Possible reasons for similarity of the dose-response curves elicited by basically different types of mutagens, shapes of curves, and absence of potentiation when treatments included both radiation and tretamine are discussed. (Auth.)

644 Lewis, L. F., Eddy, G. W. SOME EFFECTS OF GAMMA RADIATION ON THE HORN FLY. J. econ. Ent. 57, 2 (1964) 275-7.

Both sexes of the horn fly, Haematobia irritans (L.), were sterilized by irradiating pupae with a γ-ray dosage of 5000 R from a ^{60}Co source. In every test in which irradiated pupae mixed with normal pupae were allowed to emerge together in screened cages, the resulting eggs were less viable than control eggs, which indicated that treated males competed for mates with normal males with some success. Horn fly longevity in these tests was apparently unaffected by the sterilizing dosage. Methods are presented for obtaining horn fly eggs, for mass rearing these flies in the laboratory, and for sexing the newly emerged adults. (Auth.)

645 Lindsley, D. L. MALE STERILIZING MUTATIONS IN Drosophila AND THE LESION IN SPERMATOGENESIS CAUSING STERILITY. p. 106 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

646 McClanahan, R. J. STERILIZATION OF THE CARROT RUST FLY BY IRRADIATION WITH CESIUM^{137}[*]. Can. Ent. 97, 10 (1965) 1042-5.

Laboratory studies were conducted with the carrot rust fly, Psila rosae (Fabricius), to determine the effect of irradiation on reproduction. Irradiation of 15-d-old pupae with 1. 4, 2. 8 and 4. 3 kR did not adversely affect emergence. Treated females caged with normal males laid a few sterile eggs when the treatment was 1. 4 kR but none at the higher doses. Normal females caged with treated males laid a normal complement of eggs, and the per cent hatch was 10, 2 and 0 with treatments of 1. 4, 2. 8 and 4. 3 kR, respectively. When flies of both sexes from pupae treated at 3. 0 kR were mixed with normal flies in a ratio of 6:1, the number of larvae were reduced by 93%. (Auth.)

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[*] Contribution No. 61, Ent. Lab., Res. Branch, Canada Dept. of Agriculture, Chatham, Ont.

647(2) Myburgh, A. C. LETHAL AND STERILISING EFFECTS OF COBALT-60 GAMMA RAYS ON Argyroploce leucotreta. p. 514-25 of "National Conference on Nuclear Energy. Application of Isotopes and Radiation". Atomic Energy Board, Pelindba, South Africa. 1963.

Whereas extremely high exposure doses of γ-rays, ranging from nearly 200 - 400 kR, were required to inhibit development within each respective stage of metamorphosis of A. leucotreta Meyr, exposures between 10 and 120 kR, at a radiation intensity of 80 R per minute, inhibited development of moths from immature stages. Considerably lower exposure doses, ranging from approximately 5 to 70 kR, were required to achieve sterility. The stages of metamorphosis, from egg to adult, became progressively more resistant to the effects of γ-rays, while resistance also increased with age within each stage. Males were generally more resistant than females. A direct relation between radiation intensity and magnitude of effect on the species was evident. Possible application of γ-rays for control of A. leucotreta in packed fruit and in orchards is discussed. (Auth.)

648 Ostensson, L. STERILIZATION OF INSECTS. (BAg 29:1965, 52644). Mjolkpropagandan 4, 5 (1964) 139. (In Swedish)

649 Ouye, M. T., Garcia, R. S., Martin, D. F. DETERMINATION OF THE OPTIMUM STERILIZING DOSAGE FOR PINK BOLLWORM TREATED AS PUPAE WITH GAMMA RADIATION. J. econ. Ent. 57 (1964) 387-90.

The effect of γ-radiation from ^{60}Co on pupae and adults of the pink bollworm, Pectinophora gossypiella (Saunders), following pupal exposure was determined. Pupal sensitivity to γ-radiation was dependent on age at time of treatment - the older the pupae, the less susceptible they were. When 1- and 3-d-old pupae were irradiated, dosages inducing complete sterility also caused some pupal mortality and appreciable moth damage; however, irradiation of 5- or 7-d-old pupae induced almost complete sterility without pupal mortality or adult malformation. When males from irradiated 7-d-old pupae were mated with untreated females, complete sterility was achieved at 55 kR, and within the range of 30-60 kR no more than 3% of the oviposited eggs hatched at any one exposure dosage. Exposure at 40 kR was sufficient to sterilize females. Longevity of males from 7-d-old pupae treated with 35 through 90 kR was significantly shorter than that of the control. (Auth.)

650 Parfenov, G. P. THE DEVELOPMENT OF DOMINANT LETHALITY IN FRUIT FLIES EXPOSED TO VIBRATION, ACCELERATION, AND GAMMA RADIATION. Kosm. Issled. 3 (1965) 643-51. (In Russian)

The combined and individual effects of vibration, acceleration, and 500 R doses of γ-radiation on fruit flies were studied using Domodedovo-18 and -32 strains. In each test, 1000 males were mated to the same number of virgin females 1 h after exposure to a stress. The eggs of these females were subsequently collected and examined for lethality. It was found that various vibration frequencies did not injure the mature sperm of fruit flies. Egg lethality following exposure to vibration was attributed to lowered male sexual activity. Vibration with a frequency of 70 cps for 2 h or longer caused injury during the spermatid phase resulting in zygote lethality after fertilization. Regardless of the sequence, the total effect of vibration combined with radiation did not exceed the sum of each of the individual stressors. Exposure to 40 g for 20 min did not have a mutagenic effect or influence the radiation effect. A higher magnitude of acceleration (4000 g for 20 min) did not affect the spermatids but did affect mature germ cells. The effect was analogous to that of 200 to 250 R of γ-rays. The mechanism of the cellular effect of 4000 g was probably non-nuclear. Radiation followed by acceleration (4000 g) had a total effect equal to the sum of the individual effects. When the order was reversed, the radiation effect was modified. (NSA 20:1966, 14343)

651 Pendlebury, J. B., Jefferies, D. J., Banham, E. J., Bull, J. O. SOME EFFECTS OF GAMMA RADIATION ON Rhizopertha dominica (F.), Cadra cautella (Wlk.), Plodia interpunctella (Hübn.) AND Lasioderma serricorne (F.).* p. 143-56 of "Entomology of Radiation Disinfestation of Grain". Cornwell, P. B., Ed. Oxford, Pergamon Press. 1966,** 236p.

Various effects of γ-radiation on four stored-products pests, which infest grain and cereal products in varying degrees, are examined with particular emphasis on susceptibility to radiation sterilization. R. dominica, described as the most destructive pest of grain, and L. serricorne, occasionally found infesting cereal products, are effectively sterilized by the dose (16 000 rad) evaluated for the control of large populations of grain weevils. C. cautella and P. interpunctella, principally pests of dried fruits, but occasionally imported on infested cereals, are more resistant to radiation sterilization; 6000 rad is unlikely to be completely effective for their control. (Auth.)

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* For an earlier report, AERE-R-4003, see II/805.

** Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U. K. A. E. A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

652(2) Sado, T. CYTOLOGICAL ESTIMATION OF LD 50 x RAY DOSE FOR SECONDARY SPERMATOGONIA OF THE SILKWORM. Rep. natn. Inst. Genet., Misima 13 (1961) 91-92.

653 Shipp, E. SUSCEPTIBILITY OF AUSTRALIAN STRAINS OF Sitophilus AND Tribolium SPECIES TO GAMMA RADIATION. p. 131-141 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P. B., Ed. Oxford, Pergamon Press. 1966*, 236p.

No differences could be detected between laboratory and wild strains of S. oryzae and S. zeamais in the lethal effect of γ-radiation. Wild strains of S. granarius, T. confusum and T. castaneum were more resistant than laboratory strains. In the five species, only slight differences between laboratory and wild strains were found in response to sterilization by irradiation. Sterilization at the 99·9% level was obtained with all species and strains at about 10 000 rad. The dose of 16 000 rad, previously evaluated for effective control of S. granarius, can therefore be recommended for use in commercial radiation disinfestation of grain in Australia. (Auth. summary)

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* Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U. K. A. E. A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

654(1) Tazima, Y., Onimaru, K. x-RAYS INDUCED DOMINANT LETHALS FROM IRRADIATION OF DIFFERENT STAGES OF OÖGENESIS IN THE SILKWORM. Rep. natn. Inst. Genet., Misima 10 (1959) 117.

655(1) Tazima, Y. SOME OBSERVATIONS RELEVANT TO THE POSSIBLE CAUSE OF RADIATION INDUCED STERILITY IN THE MALE SILKWORM. Rep. natn. Inst. Genet., Misima 10 (1959) 118.

656 Tilton, E. W., Burkholder, W. E., Cogburn, R. R. STERILIZING EFFECTS OF GAMMA RADIATION ON EIGHT INSECT AND ONE MITE SPECIES THAT INFEST STORED PRODUCTS. Bull. ent. Soc. Am. 10, 3 (1964) 163. Abstr.

Radiation-sterilized Trogoderma glabrum males competed favourably with non-sterilized males. All beetles tested after a single continuous dosage of 25 kR were sterile. None of the dosages used sterilized two of the moth species. Acarus siro reproduced after radiation with 25 kR but not after higher dosages. (Abstr.)

657 Vereecke, A., Pelerents, C. DE INVLOED VAN GAMMASTRALEN OP DE FECUNDITEIT EN FERTILITEIT VAN Tribolium confusum Duval. (The effect of γ-irradiation on fecundity and fertility of Tribolium confusum Duval). Meded. LandbHoogesch. OpzoekStns Gent 30, 2 (1965) 1017-27. (In Flemish, with English, French, and German summaries)

The applied doses ranged from 1000 - 10 000 rad. A marked periodic increase in fecundity was observed every 3 weeks for 1000 and 2000 rad. Dosages > 5000 rad caused egg laying to stop shortly after irradiation. At 7000 rad and beyond no recovery was observed. Sterility occurred after irradiation between 4000 and 5000 rad, when < 1% of the eggs laid by beetles which had been exposed to 4000 rad developed into adults.

658 Walker, D. W., Alemany, A., Figueroa, M. INDUCED STERILITY OF ADULT Diatraea saccharalis (Fab.) BY GAMMA IRRADIATION. Bull. ent. Soc. Am. 10, 3 (1964) 167. Abstr.

Irradiation of larvae or pupae at 8 kR and higher produced excessive mortality. Irradiation of virgin, newly-emerged adult males and/or females at 20 - 40 kR produced 2% hatch or less, irradiation at higher dosages produced mixed results. Behaviour and methods are discussed.

659 Andreev, S. V., Samoilova, Z. I., Martens, B. K. THE POTENTIAL APPLICATION OF γ-RADIATION FOR THE STERILIZATION OF Chloridea obsoleta FOR THE PURPOSE OF REDUCING ITS POPULATION. Radiobiologiya 4 (1964) 624-6. (In Russian)

Experiments were carried out with the weevil C. obsoleta, which causes considerable damage in cotton crops. A 550 R/min ^{60}Co source was used to irradiate the male insects after cocoon stage at a total dose of 3-15 kR. The young caterpillars were fed with tomato plant leaves, the mature ones with ground seeds. The optimum temperature for the culture was found to lie between 23 and 25°C, at a relative air humidity of 65-70%. It was found that up to 8 R, the life span and the fertility were not noticeably affected. The optimum dose for sterilizing the male for the purpose of reducing the total population lies between 8 and 10 kR. Doses of 15 kR and higher resulted in deformed butterflies with a short life. (From NSA 18:1964, 41190)

See also:

14 Nonrandom distribution of lethals induced by tritiated thymidine in Drosophila melanogaster. (Kaplan, W. D. et al., 1964)
547 Radiosensitivity of Drosophila spermatogonia. III. Comparison of acute and protracted irradiation efficiencies in relation to cell killing. (Oftedal, P., 1964)
550 Spermatogenesis of the silkworm and its bearing on radiation induced sterility. (Sado, T., 1963)
551 Spermatogenesis of the silkworm and its bearing on radiation induced sterility. Part II. (Sado, T., 1963)
585 X-autosomal translocations of Drosophila melanogaster. (Warters, M., 1964)
606 Radiation induced viability mutations in the honey bee. (Lee, W. R., 1964)
666 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, M. L., 1964)
674 x-ray damage as measured by dominant lethals, sex-linked recessive lethals and translocations in Drosophila melanogaster and oxygen and argon as its modifying factors. (Elequin, F. T., 1965)
675 x-ray and fast neutron effects on productivity of flour beetles. (Erdman, H. E., 1965)
677 Dose ratio of x-rays to fast neutrons in producing dominant lethals in flour beetles, Tribolium castaneum. (Erdman, H. E., 1965)
694 The failure of sulphydryl compounds, AET, MEA, and glutatione to protect against x-ray induced chromosome aberrations in male Drosophila. (Mittler, S., 1964)
695 Studies of chemical protection against radiation induced genetic aberrations. (Mittler, S., 1964)

697 The effect of ATP upon radiation induced "dominant lethals" in *Drosophila*. (Mittler, S., Webster, M. C., 1964)

704 Effects of 2,4-dinitrophenol on the radioinduced dominant lethal factors in *Drosophila melanogaster*. (Nickel, E., 1965)

715 Genetic effects of cosmic radiation in *Drosophila melanogaster*. (Reddi, O. S., Sanjeeva Rao, M., 1964)

716 Influence of oxygen, helium, and metabolic inhibition on x-ray induced dominant lethality in stage 7 and stage 14 oocytes of *Drosophila melanogaster*. (Rinehart, R. R., 1964)

724 The effect of temperature during irradiation on induced mutation frequency in *Drosophila melanogaster* sperm. (Sollunn, F. J., Strømnaes, Ø., 1964)

726 Effect of temperature on radiation induced male sterility in the silkworm, *Bombyx mori* L. (Sugai, E., 1965)

727 Radiation mutagenesis in the silkworm. IV. Independence of radiation intensity as shown by induced sterility of spermatogenic cells. (Tazima, Y., 1958)

731 Mechanisms controlling two types of dose-rate dependence of radiation-induced mutation frequencies in silkworm gonia. (Tazima, Y., 1965)

734 Analysis of postirradiation modification of genetic damage in mature *Drosophila melanogaster* sperm. (Trosko, J. E., 1964)

740 Recent developments in research on radiation and chemical mutagen effects in insects. (Borstel, R. C. von, 1964)

748 Some effects of gamma radiation and a chemosterilant on the Mexican bean beetle. (Henneberry, T. J., et al., 1964)

749 Effect of chemosterilants against the oriental fruit fly, melon fly, and Mediterranean fruit fly. (Keiser, I., Steiner, L. F.)

755 Comparisons between mutagenic and cell-killing effects induced by radiation and radiomimetic substances. (Nakao, Y., 1965)

756 Radiosterilization vs. chemosterilization in house flies and mosquitoes. (Schmidt, C. H., Dame, D. A. et al., 1964)

757 A comparison of genetic changes induced by a monofunctional and a polyfunctional alkylating agent in *Drosophila melanogaster*. (Snyder, L. A., Oster, I. I., 1964)

766 Effects of gamma radiation on the fertility of the two-spotted spider mite and its progeny. (Henneberry, T. J., 1964)

801 Cytological effects of radiation on testes of the screw-worm fly, *Cochliomyia hominivorax*. (Riemann, J. G., 1964)

810 Genetic effects from simultaneous irradiation of immature and mature *Drosophila virilis* males. (Clayton, F. E., 1965)

811 Susceptibility of the grain and rice weevils, *Sitophilus granarius* (L.) and *Sitophilus zeamais* Mots. to gamma radiation. (Cornwell, P. B., 1966)

813 Some effects of gamma radiation on the potato tuberworm, *Gnorimoschema operculella* (Lepidoptera: Gelechiidae). (Elbadry, E., 1965)

823 Biological and histopathological effects of gamma radiation on three life stages of *Anthonomus grandis* Boheman. (Mayer, M. S., 1964)

829 The gamma irradiation of *Glossina* puparial stages and control. (Potts, W. H., 1965)

843 The effects of gamma radiation on the biology and behavior of forest insects and the possibility of their control. (Stark, R. W., Wood, D. L., 1964)

870 Susceptibility of laboratory and wild strains of the grain weevil *Sitophilus granarius* (L.) to gamma radiation. (Cornwell, P. B., 1966)

872 The effect of dose rate on the response of *Tribolium confusum* Duv., *Oryzaephilus surinamensis* (L.) and *Sitophilus granarius* (L.) to ^{60}Co gamma radiation. (Jefferies, D. J., Banham, E. J., 1966)

874 Susceptibility of *Callosobruchus maculatus* to high dose rate gamma irradiation. A preliminary study. (Neharin, A. et al., 1965)

887 A comparison of the susceptibility of the grain weevil *Sitophilus granarius* (L.) to accelerated electrons and ^{60}Co gamma radiation. (Bull, J. O., Cornwell, P. B., 1966)

899 The influence of temperature upon the radiation susceptibility of *Sitophilus granarius* (L.). (Pendlebury, J. B., 1966)

907 Field behavior of sexually sterile *Anopheles quadrimaculatus* males. (Dame, D. A., Woodard, D. B. et al., 1964)

924 A study of radiation on the biology and population dynamics of the cereal leaf beetle, *Oulema melanopa* (L.) order Coleoptera, family Chrysomelidae. (Myser, W. C., 1965)

991 Summary of the Mediterranean fruit fly investigation program June 1964 through May 1965. (Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador), 1965)

996 Sterilization of the navel orangeworm, *Paramyelois transitella* (Walker), by gamma radiation (Lepidoptera: Phycitidae). (Husseiny, M. M., Madsen, H. F., 1964)

1001 Control of weevil populations (*Sitophilus granarius* (L.)) with sterilising and substerilising doses of gamma radiation. (Cornwell, P. B. et al., 1966)

1002 USDA research program and facilities for the use of gamma irradiation in the control of stored-product insects. (Laudani, H. et al., 1965)

1008 Procédé et installation pour la destruction d'insectes par rayonnements nucléaires. (Boisot, M., Henrion, B., 1964)

1010 The entomology of radiation disinfestation of grain. (Cornwell, P. B., Ed.)

1012 Application of ionizing radiation to grain disinfestation. (Goresline, H. E., 1965)

1018 Dosimetry, tolerance, and shelf life extension related to disinfestation of fruits and vegetables by gamma irradiation. (Ross, E., Brewbaker, J. L., 1965)

1270 The effect of radiation on the cockchafer, *Melolontha vulgaris*. (Lavrov, M. T., Bogomaz, V. A., 1958)

7. Pesticide Resistance. Pathogen Susceptibility

See:

893 Prospects of integrated radiation and microbial control of harmful insects. (Jafri, R. H., 1965)

8. Tumour Induction

660 Burnet, B., Sang, J. H. PHYSIOLOGICAL GENETICS OF MELANOTIC TUMORS IN *Drosophila melanogaster*. II. THE GENETIC BASIS OF RESPONSE TO TUMORIGENIC TREATMENTS IN THE *tu*^{K} AND *tu bw*; *st su-tu* STRAINS. *Genetics* *49* (1964) 223-35.

The inbred *tu*^{K} and *tu bw*; *st su-tu* strains of *D. melanogaster* have a low incidence of melanotic tumours when cultured on a complete, defined medium under germ free conditions. Sub-optimal balances of pentose nucleotides in the larval diet, cholesterol deficiency, an excess of L-tryptophan, and exposing embryos to x-irradiation, cause an increase in tumour penetrance in the two strains and their F_1, but there are quantitative differences between them. The response of the *tu*^{K} strain to treatment is due to a gene of low penetrance (*tu*^{K}) on the second chromosome, and a recessive enhancer modifier (e-*tu*^{K}) on chromosome three. The response of the *tu bw*; *st su-tu* strain is also due to a tumour gene (*tu bw*) on the second chromosome, which in normal environmental conditions is hypostatic to a recessive third chromosome suppressor (*su-tu*). It is fully penetrant in the absence of environmental treatments in genotypes containing the dominant allele (+*su-tu*) of the suppressor locus. Dietary-environmental treatments that increase tumour penetrance are thought to influence the reaction controlled by the tumour gene, rather than to interfere with the action of a specific tumour suppressor. (Auth.)

661 Burnet, B., Sang, J. H. PHYSIOLOGICAL GENETICS OF MELANOTIC TUMORS IN *Drosophila melanogaster*. III. PHENOCRITICAL PERIOD IN RELATION TO TUMOR FORMATION IN THE *tu bw*; *st su-tu* STRAIN. *Genetics* *49* (1964) 599-610.

Attempts to define the phenocritical period for the *tu* gene, in the *tu bw*; *st su-tu* strain, by environmental treatments show that the period in which tumour penetrance can be influenced by x-rays differs in time and duration from the periods in which dietary environmental treatments are similarly effective. The x-ray sensitive period begins early in embryonic development and terminates after the beginning of the 1st-larval-instar. The sensitive periods for excess dietary tryptophan, cholesterol deficiency, and suboptimal balances of dietary nucleotides, are the same within the limits of resolution of the experimental data, beginning towards the end of the second instar and terminating after the beginning of the 3rd instar. x-ray and dietary environmental treatments consequently influence tumour penetrance through temporally different developmental reactions. Since x-ray and dietary treatments cause an increase in tumour penetrance in strains homozygous for the tu bw second chromosome, irrespective of the allelic combination present at the suppressor locus on chromosome three, they have a direct influence on the penetrance of the tumour gene, rather than an indirect effect due to interference with the phenotypic expression of the suppressor. (Auth.)

662 Ghélélovitch, S. THE TUMORIGENIC EFFECT OF x RAYS ON Drosophila (D. melanogaster) AND ITS QUANTITATIVE DEVELOPMENT IN THE COURSE OF ONTOGENY. Bull. Ass. fr. Etude Cancer 51 (1964) 203-24 (In French).

The D. melanogaster strain cl tu has a hereditary predisposition to melanotic tumours. Another strain, 8, does not have the genetic predisposition to tumours. The cl tu larvae were exposed to x-rays at age 22, 48 or 70 h. Of the 22 h controls, 59. 2 ± 2. 9% developed tumours. After 600 R, 89. 8 ± 2. 3% developed tumours. After 1200 R, 100% had tumors, and after 2400 R, 93.4 ± 2. 1%. Tumour development in the 48 h larvae was: control, none; 600 R, 60. 6 ± 3. 5%; 1200 R, 91.8 ± 2.1%; and 2400 R, 93.4 ± 1.8%. At 70 h, the results were: 600 R, 60. 6 ± 4. 1%; 1200 R, 83. 7 ± 2. 3%; and 2400 R, 97. 7 ± 1. 0%. In a second experiment, after exposure to 300 R, 84. 4% of the 1st larval stage developed tumours. In the 2nd stage, 63. 7% developed tumours, and in the 3rd stage, 54. 2%. After 600 R the results were: embryos: 85. 4% tumour growth; 1st stage: 80. 7%; 2nd stage: 54. 9%; and 3rd stage: 42. 9%. Radiosensitivity depended on the developmental stage, not the age of the larvae. But the period of change in sensitivity did not correspond to the moulting period. Whether the irradiation was done to the eggs or larvae of a given stage, tumours did not become visible until the last day preceding pupation. With an appropriate dose of x-rays, tumours can be induced in almost all cl tu larvae, regardless of age. With large x-ray doses (over 2-3000 R) a threshold of inversion was reached. Beyond this threshold the incidence of induced tumours declined. In the cl tu and F$_1$ (cl tu × 8) strains, the statistical distribution of tumours followed the Poisson series, until the multiplicity of tumours increased. In the heterozygotes there was an excess of larvae without tumours and a decrease in frequency of those with only one tumour. (NSA 19:1965, 27982)

663(2) Ghélélovitch, S. PHYSIOLOGIC FACTORS DETERMINING IN THE FORMATION OF MELANOTIC TUMORS IN Drosophila (D. melanogaster). INFLUENCE OF HEAT AND IRRADIATION. Bull. Ass. fr. Etude Cancer 50 (1963) 399-411. (In French)

The effects of heating and irradiation were combined to investigate the process of tumour development in this insect. In the various experiments x-irradiation (600-3000 R) either preceded or followed the application of heat to the larvae. Results showed that thermal treatment in all cases significantly decreased the number of pupae presenting tumours, but had no effect on the multiplicity of tumours appearing in those insects in which heat failed to have an effect. Heat also did not modify the size of the developed tumours, which were much larger in irradiated animals by comparison with the non-irradiated. Sensitivity to heat increased in both irradiated and non-irradiated larvae with increased age. Heat had less effect on irradiated than non-irradiated larvae; this was clearly demonstrated when heat was applied from the 24th-48th h of larval life. Tumour formation was inhibited in 50% of non-irradiated larvae, but larvae receiving 600 R at age 24 h were not affected. These results showed the necessity for distinguishing at least two stages in Drosophila tumour development. Three factors operate in the manifestation of this phenomenon: cellular sensitivity, which can be increased by irradiation; tumorigenic stimulus, the effectiveness of which depends on genetic constitution; and the promoting factor, which can be inhibited by heat. Heat may completely suppress the probability of tumour development but cannot modify the process quantitatively. (From NSA 19:1965, 8829)

9. Modifying Factors

(Intensity. Mode of Irradiation. Ploidy. RBE. LET. Temperature. Synergists. Chemicals including Protective Agents. Environment at Irradiation. Medium. Irradiated Macromolecules. Etc.)

664 Abeleva, E. A. CHANGE IN THE NATURE OF RADIATION-INDUCED MUTATION IN THE SPERMATIDS OF Drosophila UNDER THE INFLUENCE OF ARGININE. Radiobiologiya 4, 3 (1964) 426-31. (In Russian). English Translation: AEC-tr-6406. Radiobiology 4, 3 (1964) 138-46.

Distribution curves of the frequency of recessive sex-linked lethals induced by doses of 1000 R of γ-radiation from a ^{60}Co-source were plotted for 11 successive 1-d-matings. The flies had been raised on ordinary or arginine-containing medium. The curves differed substantially only in the region corresponding to irradiated spermatids (the phase of nucleoprotamine synthesis). The genetic radiosensitivity of males which had been given arginine at the most radiosensitive phases (5th-6th day) decreased almost to the level of sperm cells. A characteristic reduction in radiosensitivity in sperm of males which had received arginine occurred a day earlier. The phase of increased radiosensitivity was reduced. Support is lent to the supposition that the mutation process in spermatids is of a biochemical nature.

665 Baxter, R. C. LETHALS IN Drosophila SPERMATOGONIA AFTER FRACTIONATED x-IRRADIATION. p. 34-35 of "University of Rochester, Atomic Energy Project. Brief Description of Most of the Research Programs Completed during 1964". UR-668, Rochester Univ., N. Y. Atomic Energy Project. 1 Jan. 1965, 175p.

Experiments were carried out in order to measure the incidence of sex-linked lethal mutations induced in D. melanogaster spermatogonial cells after single and fractionated exposure to x-irradiation. When males are irradiated with a single dose of 2000 R and then aged for 20 d without females, the lethal frequencies found for each of 5 brood tests are remarkably similar to that found for brood 5 of the males aged for 20 d and then given a single dose immediately before brood testing. Spermatozoa not used in copulation are clearly either absorbed or ejaculated, and are definitely not retained for long periods of time. Dose fractionation results in a highly significant reduction of lethals induced in spermatogonial cells, not attributable to repair or recovery mechanisms at the cellular level. A total dose of 2000 R is genetically and biologically more effective in producing lethal mutations when given as a single dose than when fractionated over 20 d at 2000 R/d.

666 Alexander, M. L. THE EFFECTS OF RADIATIONS ON THE GENETIC SYSTEMS OF ORGANISMS IN RELATION TO THEIR PHYSIOLOGICAL AND BIOCHEMICAL SYSTEMS. p. 137 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID, 4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

667 Alexander, M. L. GENETIC EFFECT OF COMBINED x-RAY AND ETHYLENIMINE TREATMENTS. Genetics 52, 2, Pt. 2 (1965) 426. Abstr.

1-d-old males of Drosophila melanogaster were treated with 1500 R of 250 kVp x-rays or injected with 0.0004 ml of a 0.01 M concentration of ethylenimine, or the two treatments combined. Males were mated, individually, to three M-9 females (sc^{S1} In S w^a sc^8; Cy/BlL^2) every three days. Sex-linked recessive lethals were observed in samples from six remating periods. The results for x-rays were typical for radiation treatment with 3.6% or 3.0% lethals induced in mature sperm in two separate experiments. The rates increased to 11.06% or 11.8% in period C which probably represents spermatids. In meiotic and premeiotic stages the lethal rates were 2% or less. With ethylenimine treatment, the lethal rates were 2.9, 2. 2 and 1. 0% for the first three remating periods for 1-d-old males. When 7-h-old adult males were injected, the rates were 5. 6, 7. 8 and 4. 0% for the same three periods. The rate then drops to 1% or less as in all previous experiments. When the treatments were combined, the sex-linked recessive lethal rates were approximately additive for the rates of the radiation and chemical treatments in postmeiotic cells. For mating period A, the combined treatments gave 5. 5% in the first experiment and 6. 11% in the second. In period C, the rates were 16. 9% for the first and 15. 2% for the second experiment. Rates for the combined treatments are less predictable for meiotic and premeiotic germ cells. (Abstr.)

668 Bychkovskaya, I. B., Ochinskaya, G. K. STUDY OF THE "OXYGEN EFFECT" AT VARIOUS RADIATION DOSE RATES. Radiobiologiya 4, 1 (1964) 63-66. (In Russian). English Translation: AEC-tr-6404. Radiobiology 4, 1 (1964) 85-90.

Calandra granaria can tolerate anoxia for a limited period. x-Irradiation of the beetles was carried out at 200 kV and 20 mA, filter 0.5 mm of Al, 0.25 mm of Cu, at dose rates of 500 and 50 R/min. Oxygen concentrations from 0-21% were used. The dependence of radiation injury of the granary weevils on O-concentration of the medium at the time of irradiation was characterized by an S-curve with a sharp increase in injury at a certain O-concentration and an "oxygen ceiling". Within a certain range of O-concentrations, radiation injury varied with very small changes in O-concentration whereas variations in dose rate within a considerably wider margin did not affect it. The magnitude of the O-effect at various dose rates cannot be determined in a quantitative fashion as a simple function of the radical concentration per unit time and the O-concentration. The significance of this factor can be admitted only for very high dose rates, not investigated in this study.

669 Carlson, E. A., Novitski, E. COMBINED ICR 100 AND x-RAY ANALYSIS OF THE STRANDEDNESS OF THE SPERMATOZOAN OF Drosophila melanogaster. Genetics 50, 2 (1964) 239-40.

To test the chromatid composition of spermatids, Oregon-R wild-type males were injected with ICR 100 (monofunctional quinacrine mustard). Half of these males were irradiated with a 3000 x-ray dose 24 h after injection. The other half were not irradiated. A third batch of wild-type males were irradiated with 3000 R at the same time as the preinjected series, but no ICR 100 was received by these males. All three groups were mated to ed dp cl (echinoid dumpy clot) virgin females. The F_1 were scored phenotypically for mosaic and complete mutations at the dumpy locus. The results showed no conversion of ICR 100 mosaic dumpies into complete dumpies through loss of a non-mutant chromatid in spermatids assumed to bear two chromatids per chromosome. The lack of change in the ICR 100 mosaic dumpy frequency supports, but does not prove, the model of a spermatid containing one chromatid per chromosome. Loss of the single chromatid through breakage in this model should result in a total loss of the mosaic rather than its conversion to a complete mutant. The results are summarized as follows: for ICR 100 alone, 12 mosaic dumpies and 3 complete dumpies among 4740 progeny; for 3000 R alone, 6 mosaic dumpies and 9 complete dumpies among 6185 progeny; for combined ICR 100 + 3000 R, 23 mosaic dumpies and 7 complete dumpies among 4431 progeny.

670 Chopra, V. L. TESTS ON Drosophila FOR THE PRODUCTION OF MUTATIONS BY IRRADIATED MEDIUM OR IRRADIATED DNA. Nature, Lond. 208 (1965) 699-700.

Food (10% dried killed yeast, 10% sucrose, 3% agar in water) were exposed to 1 mrad of γ-radiation in a single exposure. In the first experiment, 24- and 48-h-old larvae were transferred to the irradiated food about 36 h after exposure (termination), and the frequency of sex-linked and second chromosome (autosomal) lethals determined simultaneously in both males and females. In a second experiment, the usual maize meal-molasses food was used. Young Or-K females, mated 24 h earlier were transferred to irradiated food for egg laying immediately after exposure, so that developing flies should be exposed to the full effect. Results (tabulated) do not provide any evidence for a mutagenic substance being produced in irradiated food. – DNA from herring sperm was exposed to 100 000 R of γ-radiation (31 min exposure), then mixed with Drosophila food, and flies were then allowed to oviposit on it. The development of the flies was considerably delayed, first emergence taking 14 d (controls 9-10 d). In 1089 chromosome from 91 males developing on the above food (2200 chromosomes from 167 control males) the percentage of sex-linked lethals was 0.18 (0.22). A mutagenicity of irradiated DNA for Drosophila is not supported.

671 Come, T. V. MORPHOLOGICAL AND REPRODUCTIVE VARIATION UNDER FOUR ENVIRONMENTAL PRESSURES IN AN INBRED STRAIN OF Drosophila melanogaster. Diss. Abstr. 25, 2 (1964) 764.

The primary objective of this study was to determine the effect of radiation induced mutations on the level of homozygosity, in an inbred line of D. melanogaster, as determined by variance in phenotypic responses. The study contained three major aspects: selection for thorax length, genotype-temperature interactions, and small population density effects. The study indicates that genetic variability for thorax length is present in this highly inbred stock. Also, the factors concerned with size are, at least in part, epistatic to viability. Numerous inconsistencies were observed in the results, but the following conclusions seem valid: 1. Radiation reduces fecundity and contributes to a reduction in offspring body size. 2. Low larval density will affect body size, with or without irradiation. 3. Selection pressure reduces fecundity particularly in the lines selected for small size. 4. Selection pressure is effective in this inbred line, but not symmetrical. 5. Temperature variations can affect body size and fecundity. 6. Selection for large thorax has a positive effect on viability at higher temperatures. 7. At larvae densities below 50 there is a linear relationship between size and density. 8. At higher temperatures more females are produced. (From DA)

672 Dubinin, N. P., Arsenieva, M. A., Glembotskiĭ, Ya. L., Dubinina, L. G., Kozlov, V. M., Shevchenko, V. A. GENETIC EFFECT OF SMALL DOSES OF IONIZING RADIATION. A/CONF. 28/P/386, 3rd UN International Conference on the Peaceful Uses of Atomic Energy. May 1964, 20p.

P. 1-5 describe an investigation on the effects of fractionated doses of γ-rays, neutrons (1 MeV), and protons (126-130 MeV) on lethal and sublethal sex-linked mutations in Drosophila. A comparison of a number of sex-linked recessive lethals and sublethals per 1 rad/10^7 gametes induced by irradiation with small doses and by a single irradiation at a level of 1000 rad shows that small doses (20 rad in one treatment of fractionated irradiation at 5 rad per treatment) produce far more point mutations (mainly recessive lethals) than do high doses. It is concluded that the genetic effects of small doses are cumulative and that no efficient chemical protection against such effects is possible.

673 Ducoff, H. S., Bosma, G. C. EVALUATION OF REPAIR PROCESSES IN x-IRRADIATED FLOUR BEETLES BY MEANS OF THE SPLIT-DOSE TECHNIQUE. Radiat. Res. 22, 1 (1964) 185. Abstr. 53.

As a prelude to investigation of recovery mechanisms in irradiated insects, the rate and the degree of recovery in x-irradiated flour beetles (Tribolium confusum Duv.) have been measured by the split-dose technique. If larvae received a single dose, 80-100% survive (are alive 5 weeks later as normal-appearing adults) exposure to 2.5 kR, but 0-20% survive after 5 kR, under "standard" conditions (30°C, 60% relative humidity, medium consisting of 96% white flour-4% dried yeast). Larvae were exposed to an initial dose of 2.5 kR, and a second 2.5 kR dose was administered at varying time intervals afterwards; the existence of at least two distinct components of injury was apparent. One injury component is repairable within 4 h or less; the other is not demonstrably altered within 48 h. The two components are about equal in magnitude. Adults are much more radioresistant, having an LD50 of approximately 12 kR, but exhibit little or no repair with intervals up to 24 h between two 7 kR exposures. It seems likely that both the greater resistance and the absence of rapid repair are associated with the absence of mitotic activity in the somatic tissues of the adult insect. (Abstr.)

674 Elequin, F. T. x-RAY DAMAGE AS MEASURED BY DOMINANT LETHALS, SEX-LINKED RECESSIVE LETHALS AND TRANSLOCATIONS IN Drosophila melanogaster AND OXYGEN AND ARGON AS IT'S MODIFYING FACTORS. Diss. Abstr. 26 (1965) 637.

D. melanogaster (Oregon-R strain) males, 17-24 h old, were x-rayed with two fractions of 500 R each, separated by an interval of 20 min. The two x-ray fractions in any given experiment were given in the same gas, either O_2 or Ar. During the interval between the two x-ray fractions, the flies were kept either in O_2 or in Ar. Within 1 h after the x-ray treatments each male was mated simultaneously to the following number of virgin females for the measurement of induced sex-linked recessive lethals, translocations and dominant lethals, respectively: (1) two or three y Muller-5 females; (2) two or three bw, st females; (3) one female derived from the cross between the males of Canton-S strain and the females of Austin strain. For the experiment in which the flies were x-rayed in O_2 and were kept in Ar between the two x-ray fractions, an increase in the damage as measured by sex-linked recessive lethals, dominant lethals and translocations was observed in the spermatid stage over that observed in the experiment in which the flies were x-rayed in O_2 but kept in O_2 between the two x-ray fractions. Peak sensitivities occurred at the early spermatid and meiotic stages. In the absence of O_2 during treatment, the differential response is much less obvious. With the x-rays given in Ar, no significant difference was found in the induced sex-linked lethals and translocations between the Ar and O_2 treatments during the interval between two x-ray fractions. For the dominant lethal tests, the results were the opposite of what were expected. Of the total translocations recovered, the Y-chromosome was involved in less than half and showed no preference for either one of the two major autosomes (2 and 3). The frequency of the translocations involving chromosomes two and three is 2.6 times as great as the Y-A (autosome) translocations. Chromosomes two and three were about equally affected by the x-ray treatment. In the F_1 matings, a greater amount of sterility was observed in the translocation tests for the in-oxygen, x-ray treatment than for the in-argon, x-ray treatment. The in-argon, x-ray treatments had about the same number of sterile matings as the controls. The pattern of sterile F$_1$ matings for sex-linked lethals is not consistent, indicating that the irradiated genomes behave differently in males and females.

675 Erdman, H. E. X-RAY AND FAST NEUTRON EFFECTS ON PRODUCTIVITY OF FLOUR BEETLES. p. 137-39 of "Hanford Biology Research Annual Report for 1964". BNWL-122, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jan. 1965, 229p.

Effects of temperature, x-ray, and the sex irradiated were studied for the day-old flour beetle, Tribolium castaneum (Herbst). Onset of reproduction was earlier and productivity greater as temperature increased. A 4 kR exposure of females delayed reproductive onset by 2-3 d. Productivity was reduced by 2 and 4 kR. Radiation effect on productivity was additive when both sexes were x-rayed. The ratio of doses required to produce 50% dominant lethals was 2.4: 1 relative to 250 kV potential x-rays and 4.6 MeV fast neutrons. (Auth.)

676 Erdman, H. E. EFFECTS OF A SULFOXIDE COMPOUND ON FLOUR BEETLES EXPOSED TO X-RAYS. p. 142 of "Hanford Biology Research Annual Report for 1964". BNWL-122, Battelle-Northwest, Richland, Wash. Pacific Northwest Lab. Jan. 1965, 229p.

The effects of various sulphoxide compounds on the sensitivity of flour beetles, Tribolium confusum and Tribolium castaneum to x-radiation was investigated. Results are presented in tabular form. (NSA 20:1966, 10504)

677 Erdman, H. E. DOSE RATIO OF X-RAYS TO FAST NEUTRONS IN PRODUCING DOMINANT LETHALS IN FLOUR BEETLES, Tribolium castaneum. HW-SA-3719, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Nature, Lond. 205 (1965) 99-100.

The dose ratio of 250 kV x-rays and fast neutrons of mean energy 4.6 MeV for 50% dominant lethals in flour beetles, T. castaneum, observed during 2 weeks post-irradiation are reported. The term dose ratio is used since dose-response curves (dominant lethals) were of the multihit type curves for x-rays and one-hit type for fast neutrons. Fast neutrons were found to be 2-3 times more effective than x-rays in producing 50% dominant lethality. The mean dose ratio of 2.4, which produced 50% dominant lethals in Tribolium, corresponds with the value of 3.4 in Drosophila. (NSA 19:1965, 10852)

678 Fahmy, O. G., Fahmy, M. L. GENETIC PROPERTIES OF EXOGENOUS DEOXYRIBONUCLEIC ACID AT VARIOUS LEVELS OF DEGRADATION IN Drosophila melanogaster. Nature, Lond. 207 (1965) 507-10.

Homologous DNA was exposed in the gel-state to a massive dose of γ-rays (> 230 000 R). Degradation of DNA by ultrasonics or γ-radiation did not alter the type of mutations induced, but only increased the mutagenic efficiency as regards the induction of small chromosome deletions (Minutes). These results, which show the inactivity of degraded homologous DNA as regards sex-linked recessive lethals, are in clear contradiction with Parkash's report (711) that these mutations were produced at a high rate (5.7%) among the progeny of flies fed with an unspecified sample of irradiated DNA (presumably heterologous), when it was further suggested that part of the macromolecule was incorporated into the nuclei of the fly's germ line.

679$^{(2)}$ Fritz-Niggli, H., Diener, E., Schleuss, P. SAUERSTOFFEFFEKT NACH KONVENTIONELLER RÖNTGEN- UND HOCH ENERGETISCHER ELEKTRONENBESTRAHLUNG BEI EINER STRAHLEN-MODIFIKATION (PHÄNOKOPIE). (Oxygen effect after conventional x-ray and high-energy electron irradiation in a radioinduced modification (phenocopy)). Biophysik 1 (1963) 51-59. (In German)

By irradiation of 5-h pre-pupa of D. melanogaster the wing placement of the adult flies was changed in the sense of spreading. The origin of this radio-induced modification, which represents at the same time a phenocopy, is dependent on genetic factors, since two different inbred strains were distinguished from one another by their radiation sensitivity. The biological effectiveness of electrons and photons were compared. Irradiation in pure N$_2$ hindered drastically the origination of the anomaly (a reduction from 98% injuries by 5000 R of 30-MeV electrons to 5%). No difference in protective effect was observed for 30-MeV electrons or 180-keV photons. The oxygen effect was postulated to be a blocking of processes in the macromolecular region. (NSA 17:1963, 30307)

680$^{(2)}$ Glembotskii, Ya. L., Lapkin, Yu. A., Parfenov, G. P., Kamilova, E. M. THE INFLUENCE OF COSMIC FLIGHT FACTORS ON THE FREQUENCY OF SEX-LINKED RECESSIVE LETHAL MUTATIONS IN Drosophila melanogaster. Kosm. Issled. 1 (1963) 326-34. (In Russian)

Experiments carried out during Vostok-3 and -4 flights revealed various types of mutations in D. melanogaster. Data from these flights were correlated with data obtained during five previous flights. In spite of the great variety of reactions found, a certain parallelism was observed in the heredity of insects exposed to the same conditions. Weightlessness, vibrations, acceleration, and cosmic radiation are postulated to combine and produce some variations in mutagenic reactions. (NSA 18:1964, 41129)

681 Ikenaga, M., Kondo, S. COMPARATIVE STUDIES OF MUTATION FREQUENCIES INDUCED BY ^{32}P TREATMENT AND γ-IRRADIATION IN THE MALE SILKWORM. Mutation Res. 2, 6 (1965) 534-43.

A wild type strain (C 108), and a marker strain homozygous for pe (pink egg, V-0.0) and re (red egg, V-31.7) were used. The frequency of mutation induced in the male silkworm fed with ^{32}P on the 3rd d of the 4th instar (shortly before meiosis) was compared with that induced by γ-irradiation. The daily dose of γ-rays was carefully adjusted day by day so as to fit the daily change in the absorbed dose delivered to the gonad by the ingested ^{32}P. The gonad dose for the ^{32}P treated group was estimated by applying Loevinger's equation (see Loevinger et al. "Radiation Field and Their Dosimetry: Discrete Radioisotope Sources". p. 693-799 of "Radiation Dosimetry". Hine, G. H., Brownell, G. L., Eds., New York, Academic Press. 1956); the parameters involved in the equation were experimentally determined with special care for biological factors. Using the ^{32}P dose estimates thus determined, we found that the mutation frequency was equal for the ^{32}P and γ-ray groups at the same absorbed dose. The authors conclude that there could be no chance for a mutation induced by ^{32}P transmutation to show up under the existing conditions and that the proposed ^{32}P dosimetry is satisfactory.

682 Ives, P. T. THE COMPARATIVE PATTERN OF MUTAGENESIS IN Drosophila SPERMATOGENESIS AFTER X RAYS VS Co^{60} GAMMA RADIATION. Genetics 50, 2 (1964) 258. Abstr.

Irradiated by x-rays (110 kV, 10 mA, 1 mm Al) D. melanogaster Oregon-R/cn bw ♂♂ were tested for X-linked mutations using the same exhaustive mating scheme for days 1-12 as reported in Genetics 48:1963, 981-95 for ^{60}Co tests. After 1 kR of x-rays the daily pattern of mutagenesis was very similar to that shown earlier by Oregon-R/ruc-th ♂♂ in the ^{60}Co γ study. The x-ray tests produced after 1 kR 188 mutations in 6837 tests (2.7%) of days 1-3 sperm, and 87 in 861 tests (10.1%) of day-6 sperm. After 2 kR there were 392 mutants in 7749 days-1 to 3 sperm (5.1%) and 150 in 768 days-5 to 7 sperm (19.5%). There was a similar linear dose-rate relationship between 1 kR and 2 kR throughout the days 1-12 period. There was no evidence of any difference in effect between x-rays and ^{60}Co γ-rays. (Abstr.)

683 Iyengar, S. V. THE EFFECT OF COLD PRETREATMENT ON RADIATION EFFECTS AS RELATED TO AGE IN Drosophila melanogaster. Genetics 50, 2 (1964) 258-59. Abstr.

Two age groups, young (0-24-h-old) and old (2-week-old) Drosophila males having the Y^c: bw$^+$ (marked ring Y) chromosome were each divided into four series. (a) untreated young and old controls (Y, O); (b) males subjected to -8°C for 15 min (CY, CO); (c) males that received 2500 R (YX; OX); and (d) males that were subjected to -8°C for 15 min prior to irradiation (CYX, COX). Males of all series were mated to virgin females of a suitable stock that enabled the detection of exceptional males showing the loss of the Y-chromosome and/or its bw$^+$ gene and the loss of the parental X-chromosome. Broods were made every 3d and cultures were maintained at 25°C. Combined results for the first four broods were as follows (exceptional males/total): Y, 9/3531 (0.25%); CY, 9/3700 (0.24%); YX, 18/2937 (0.61%) and CYX, 20/2706 (0.73%). O, 3/3143 (0.09%); CO, 4/1396 (0.28%); OX, 21/1778 (1.18%) and COX 6/1577 (0.38%). The control groups would show few if any losses of the parental X-chromosome, thus almost all exceptions would represent losses of the Y-chromosome. Results seem to indicate differential response of the two age groups to these physical agents. Sterility tests on all exceptional males have been carried out. Bilateral mosaics appeared only in the young group. Older males suffer a serious reproductive setback due to cold-pretreatment. (Abstr.)

684 Khan, A. H., Alderson, T. MUTAGENIC EFFECT OF IRRADIATED AND UNIRRADIATED DNA IN Drosophila. Nature, Lond. 208 (1965) 700-2.

The effects of adding irradiated DNA to chemically defined and axenic Drosophila medium were investigated. Calf-thymus DNA as a dry powder was exposed to 100 000 R (exposure time 6 min 12 sec). Newly hatched Or-K larvae were allowed to develop into adults on the above medium, containing 5% irradiated or 5% unirradiated DNA. Results are tabulated. Both DNA experiments show a significant increase in F_1 autosomal recessive lethal-mosaicism compared with the control. Tables 2 and 3 show, however, that the irradiation of calf-thymus DNA, prior to its addition to the larval medium does not produce a significant increase in mutation in Drosophila.

685[2] Khishin, A. F. E. EFFECTS OF STORING x-RAYED SPERMATOZOA ON THE FREQUENCY OF TRANSLOCATIONS AND SEX-LINKED LETHALS IN Drosophila melanogaster. Z. VererbLehre 94, 3 (1963) 280-4. (In English)

x-Rayed adult males of D. melanogaster were left with untreated females from 2-3 d after which the males were discarded. Sex-linked recessive lethals and translocations were scored in progeny produced during the first 2 or 3 d following irradiation, and after storage of the spermatozoa in the females for 6 d. The results obtained show that the frequencies of sex-linked lethals and of translocation involving the two large autosomes and the X-chromosome were unchanged by storage. In experiments in which Y, 2, 3 translocations were scored both the 2-3, and the Y translocations showed a slight increase. These experiments show that the strong storage effect on translocations produced by certain alkylating agents is peculiar to chromosomes treated by these chemicals. (Auth. summary)

686 Kondo, S. RBE OF FAST NEUTRONS TO γ-RAYS FOR MUTATIONS IN RELATION TO REPAIR MECHANISMS. Idengaku Zasshi (Jap. J. Genet.) 40, Suppl. (1965) 97-106.

A brief review of relative biological effects (RBE) for somatic and genetic damage is given for various organisms. A brief summary is given concerning comparative studies of mutation frequencies with silkworm irradiated with γ-rays, 14 MeV neutrons, and fission neutrons. From the analysis of the silkworm data combined with the above mentioned review of RBE data for other organisms, the following hypotheses are proposed: The overall mutation frequency in silkworm gonia depends on the interaction of radiation with the intercellular repair mechanisms connected with certain multi-cellular organs, and the low mutation rate recovered on acute γ-irradiation of silkworm larvae at the late gonial stage is due to stimulation of repair by radiation. (Auth.)

687 Künkel, H. A. GIBT ES EINEN GENETISCHEN STRAHLENSCHUTZ? (Does genetic radiation protection exist?). Atompraxis 10, 7 (1964) 301-5. (In German)

The various hypotheses being discussed at present in regard to the effective mechanism of chemical radioprotective substances admit (in contrast to previous views) the possibility that direct radiation effects, e.g. radiation-induced point mutations, can also be influenced by so-called protective substances. Extensive genetic experiments with Drosophila melanogaster and also with Bacterium coli have shown that application of cystein and also of serotonin before irradiation reduces the induction of mutations. On the other hand, the compound aminoethylisothiuronium (AET), which is known to be especially effective against somatic radiation damage, caused a significant increase in the radiation-induced mutation rate. (Auth.)

688 Künkel, H. A., Trams, A., Henke, H. EFFECT OF 5-HYDROXYTRYPTAMINE (SEROTONIN) ON THE RADIATION-INDUCED RATE OF MUTATION IN Drosophila melanogaster. Naturwissenschaften 52, 23 (1965) 650. (In German)

The percentage of recessive, sex-linked, lethal mutations produced in D. melanogaster with 3000 rad was 7.9%, and was 1.6% in flies treated with 0.1 mm^3 of a 1% solution of serotonin injected intra-abdominally. In flies treated with serotonin 10 min before irradiation, the percentage of recessive, sex-linked, lethal mutations was 15.8%. The results were not caused by the addition of the effects of the two mutagenic factors, but were produced by an irradiation-sensitizing effect of serotonin which, in different biological systems, can have a radioprotective effect. (CA 64:1966, 3940d)

689 Kuzin, A. M. THE THEORY OF BIOLOGICAL ACTION OF FAST NEUTRONS. Radiobiologiya 4, 1 (1964) 18-22. (In Russian)

The literature is reviewed on the RBE of irradiation by neutrons in comparison with γ-rays. From the classical target theory, neutron irradiation should be less effective because of the high ionization density and high loss of energy in passing through a structure. However, numerous experiments have shown that neutron irradiation is more effective than γ-irradiation. The neutron RBE values for 10 tissues including Drosophila are tabulated. Comparison of acute and chronic radiation effects indicates a higher RBE in the chronic action of small doses of neutrons. The cumulative damage from neutrons is considered different from that due to γ-irradiation. The structural-metabolic theory proposed by this author earlier considers the damage due to structural, metabolic, and recovery factors, continuously taking place in the living cell. A formula is presented for calculating the effect.

690 Lefevre, G., Jr., Jonsson, U.-B. THE EFFECT OF MATING INTENSITY ON MUTATION FREQUENCY PATTERNS DETECTED AFTER IRRADIATION OF Drosophila melanogaster MALES. Genetics 50 (1964) 879-90.

The patterns of mutation frequencies detected at daily intervals following irradiation of adult males with 4000 R are strikingly affected by the mating regimen that is subsequently applied to them. This fact implies that differential mutability, not recovery from the genetic effects of irradiation, is responsible for the U-shaped mutation frequency curve observed after irradiation. When males are allowed to mate but once a day, the successive sperm samples generally contain a mixture of sperm derived from cells that were at different stages of maturity at the time of irradiation. Thus, the variation in mutation frequency at successive intervals after irradiation is minimal. Only when irradiated males mate several times each day is it possible to obtain sperm samples derived more or less homogeneously from single stages of spermatogenesis. Even then, if mutation frequencies are collected on a daily basis, changes within a 24 h period are completely obscured. Optimally, irradiated males must be provided each day with a succession of virgin females so that observed matings can be obtained and mutation frequencies determined separately from each consecutive insemination. When this technique is adopted, the mutation frequency is seen to change drastically within the course of the first three matings after irradiation of 3-d-old males, beginning with the high mutation frequency characteristic of fully mature, motile sperm (4% per 1000R), but falling to the much lower level characteristic of immotile, immature sperm stages (1.6% per 1000R). By the 4th or 5th day after irradiation, if the mating schedule is properly adjusted, the mutation frequency rises again to a level as high as (or higher than) that characteristic of mature sperm as germ cells irradiated in the highly mutable early spermatid stage come to be sampled. Although the pattern of mutation frequencies is strongly affected by mating intensity following irradiation of adult males, the overall mutation frequency is not, so long as the entire population of postmeiotic germ cells is sampled. (Auth.)

691 Lefevre, G., Jr. FACTORS MODIFYING MUTATION FREQUENCY PATTERNS DETECTED AFTER IRRADIATION OF Drosophila melanogaster MALES. Mutation Res. 2 (1965) 22-28.

The reduction in mutation frequency associated with premating irradiated males can be explained by the higher intrinsic mutability of fully mature as compared with less mature sperm; it cannot be explained by recovery from genetic effects of irradiation. This is supported by the fact that withholding irradiated virgin 2- and 7-d-old males from mating for 24 or 48 h also reduces the mutation frequency, but only to a level intermediate between that observed in the first mating immediately after irradiation of virgin males of comparable age, and that observed from matings made 24-48 h later, if in the meantime the males have been allowed to mate repeatedly. The change in frequency of mutations detected at successive intervals after irradiation is a dynamic reflection of the progress of spermatogenesis, as germ cells having different mutabilities because they were at different stages of development at the time of irradiation are sampled one after another. (From auth. summary)

692 Magdon, E., Winterfeld, G. UNTERSUCHUNGEN ZUR WIRKUNG VON KATALASE UND PEROXYDASE AUF DIE STRAHLENINDUZIERTE MUTABILITÄT BEI Drosophila melanogaster. (Study on the effect of catalase and peroxydase on radiation-induced mutability in Drosophila melanogaster). Strahlentherapie 126, 3 (1965) 427-31. (In German, with English and French summaries)

Solutions of peroxydase or catalase were injected abdominally into adult males of D. melanogaster of the wild Berlin strain prior to irradiation with a x-ray dose of 1500 R. Using the M-5-method, the incidence of recessive sex-linked lethals at different stages of spermatogenesis was determined. Peroxydase and catalase decreased the radiation-induced mutation rate only in germ cells still in a stage of division at the time of irradiation. No significant effect on mature sperm and spermatids was observed.

693 Matsudaira, Y., Ito, T., Yamasaki, S., Ishizaka, S., Domon, M. ON THE FRACTIONAL- AND WHOLE-BODY MUTATIONS INDUCED BY SOFT x-RAYS IN Drosophila. Idengaku Zasshi (Jap. J. Genet.) 38, 4 (1964) 288-89.

2-d-old Oregon-R males were exposed to 400 R, 720 R, and 1440 R of nearly monochromatic x-rays (1.54 Å) and mated with virgin females of y w m f stock. F$_1$ females were examined for four marker genes. In the dose range employed more fractional-body mutants were induced than whole-body mutants. (Spontaneous mutation was not counted). A reverse relation has been reported by various workers in the high dose region (2000-5000 R), which appears to be consistent with results for yeast cells obtained over a wide range of doses, suggesting an analogous mechanism in two widely different organisms.

694 Mittler, S. THE FAILURE OF SULPHHYDRYL COMPOUNDS, AET, MEA, AND GLUTATIONE TO PROTECT AGAINST x-RAY INDUCED CHROMOSOME ABERRATIONS IN MALE Drosophila. Int. J. Radiat. Biol. 8 (1964) 405-13.

Pre-treatment with the mammalian radioprotective sulphhydryl compounds AET, MEA, and glutathione did not protect the Drosophila testis from radio-induced genetic damage. Protection was not given to spermatozoa, spermatids, spermatocytes, and spermatogonia. The responses measured were production of recessive sex-linked lethals, translocations, deletions, loss of X- and Y-chromosomes and dominant lethals. MEA increased the recessive lethals in the 3-6 d brood. Pre-treatment with glutathione increased the incidence of XO males in the 6-9 d brood and post-treatment in 0-3 d brood. MEA and glutathione increased the percentage of eggs that failed to develop in dominant lethal tests. (Auth.)

695 Mittler, S. STUDIES OF CHEMICAL PROTECTION AGAINST RADIATION INDUCED GENETIC ABERRATIONS. p. 113 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

696 Mittler, S. STUDIES OF CHEMICAL PROTECTION AGAINST RADIATION INDUCED CHROMOSOME ABERRATIONS. Final Report, September 1, 1961-August 31, 1965. TID-22293, Nothern Illinois Univ., DeKalb. Dept. of Biological Sciences. 1965, 41p.

Results are reported from a study on the mechanism of the radiation induced genetic changes. The protective effects of sulphhydryl compounds used to protect mammals, AET (aminoethylisothiourium dihydrobromide), MEA (mercaptoethylamine), and glutathione on radiation induced genetic damage of Drosophila testis were investigated. Protection was not given to spermatozoa, spermatids, spermatocytes and spermatogonia. The responses measured were production of recessive sex-linked lethals, translocations, deletions, loss of X- and Y-chromosomes, and dominant lethals as measured by the failure of fertilized eggs to develop. MEA did increase the recessive lethals in the 3-6 d brood. Pre-treatment with glutathione increased the incidence of XO males in 6-9 d brood and post-treatment in 0-3 d brood. MEA and glutathione increased the percentage of eggs that failed to develop in dominant lethals tests. Preliminary tests with pre-treatment with AET on radiation induced crossing-over in the male indicated that there was no protection but an enhancement of this radiation effect. (Auth.)

697 Mittler, S., Webster, M. C. THE EFFECT OF ATP UPON RADIATION INDUCED "DOMINANT LETHALS" IN Drosophila. Genetics 50, 2 (1964) 269. Abstr.

To test the hypothesis that ATP would encourage rejoining chromosomes that have been broken by radiation, ATP (crystalline disodium) at concentration of 5 mg/ml of phosphate buffer was injected 0.1 μl into male Oregon-R Drosophila either before or after irradiation at 2000 R. The males were mated at ratio of one male to three females every 3 d. The "dominant lethals" were determined by failure of fertilized eggs to develop after 24 h. Pretreatment with ATP enhanced the "dominant lethals" in broods 0-3, 3-6, 6-9 d, however ATP increased the number of eggs which develop in the 9-12 d brood. Post-treatment with ATP on the other hand protected against "dominant lethals" in 0-3 and 9-12 d broods and had no effect on the 6-9 d brood, but enhanced the 3-6 d brood. (Abstr.)

698 Mittler, S., U, R. ATP AND RADIATION INDUCED CHROMOSOME BREAKAGE IN Drosophila. Genetics 52, 2 Pt. 2 (1965) 460. Abstr.

Approximately 0.1 μl of 5 mg of ATP/ml was injected into 2-16-h-old male $X^{c2}yB$, $Ysc^{8}(y^{+})$. These males along with a control group injected with saline solution were then irradiated with 2000 R of x-rays and mated daily to a new harem of y w f at a ratio of one male to three females. The loss of the ring X-chromosome or the y^{+} portion of the Y-chromosome was ascertained by the appearance of exceptional (XO) y w f males. ATP did not prevent the loss or aid in the recovery of these chromosomes in the postmeiotic stages of spermatogenesis at the time of irradiation represented by the broods of day 0-1, 1-2, 2-3, 3-4 or 4-5. However, in the 5-6 d ATP brood there was significant reduction of XO males, 3.11% of the total offspring as compared to 4.46% in the control brood. In the next brood, day 6-7, there was no reduction of XO males; however, in broods which also represent cells in or about meiosis, days 7-8 and 8-9, there was a significant reduction of XO males in the offspring of the ATP-treated males. The control broods for days 7-8 and 8-9 had the greatest number of XO males, 7.5% and 7.25% respectively, and also the fewest offspring. There was also a reduction by ATP of XO males in brood day 9-10, which represent late spermatogonia at the time of irradiation. There were no significant differences between control and treated broods for days 10-11 and 11-12. (Abstr.)

699 Mituo, I., Kondo, S. COMPARATIVE STUDIES OF MUTATION FREQUENCIES INDUCED BY ^{32}P TREATMENT AND γ-IRRADIATION IN THE MALE SILKWORM. Mutation Res. 2 (1965) 534-43.

The frequency of mutations induced in the male silkworm fed with ^{32}P on the 3rd day of the 4th instar (shortly before meiosis) was compared with that induced by γ-irradiation. The daily dose of γ-rays was carefully adjusted day by day so as to fit the daily change in the absorbed dose delivered to the gonad by the ingested ^{32}P. The gonad dose for the ^{32}P treated group was estimated by applying Loevinger's equation; the parameters involved in the equation were experimentally determined with special care for biological factors. Using the ^{32}P dose estimates thus determined, it was found that the mutation frequency was equal for the ^{32}P and γ-ray groups at the same absorbed dose. It was concluded that there could be no chance for the mutation induced by ^{32}P transmutation to show up under the present conditions and that the proposed ^{32}P dosimetry is satisfactory. (Auth.)

700 Mukherjee, R. ACTINOMYCIN D EFFECTS ON THE FREQUENCY OF RADIATION-INDUCED MUTATIONS IN Drosophila. Genetics 51, 3 (1965) 363-7.

Oregon-R males of D. melanogaster were subjected to (1) actinomycin D + 600 rad of γ-rays; (2) 0.7 N NaCl + 600 rad of γ-rays; (3) actinomycin D; and (4) 0.7 N NaCl. Each treated male was tested for radiation-induced sex-linked recessive lethal mutations by the Muller-5 technique, for eight successive daily broods. The actinomycin D + γ-ray series showed a significant reduction in mutation frequency relative to the frequencies in the saline + γ-ray series in all the sperm samples from the 3rd- to 6th-d brood. The data are consistent with the model of a protein-dependent process of mutation fixation of radiation-induced premutational genetic damage. (Auth. summary)

701 Murakami, A., Kondo, S. RELATIVE BIOLOGICAL EFFECTIVENESS OF 14 MeV NEUTRONS TO γ-RAYS FOR INDUCING MUTATIONS IN SILKWORM GONIA. Idengaku Zasshi (Jap. J. Genet.) 39, 2/3 (1964) 102-14.

The RBE of 14 MeV neutrons and ^{137}Cs γ-rays in the induction at marked loci of visible recessive mutations in early and in late gonial cells was investigated, and a dose-frequency curve for each radiation obtained. The curves were qualitatively similar, an initial linear part being followed by an exponential rise with increasing dose. A drop in mutation rate appeared after irradiation with neutron doses of 2000 rad for early and late spermatogonia and late oogonia. These data fit the selective killing hypothesis. Below 1000 rad more or less similar mutation rates were observed in early and late gonia of both sexes; above 2000 rad, the mutation frequency in late groups was much higher. The mutation frequencies in late gonia due to neutrons were much higher than after exposure to γ-rays, whereas they were almost equal for early gonia. The RBE was found to be very sensitive to the stage of the germ cell, being ~ 1 for early gonia and 2-3 for late gonia (at the level of 10^{-3} mutation frequency).

702 Murakami, A., Kondo, S., Tazima, Y. COMPARISON OF FISSION NEUTRONS AND γ-RAYS IN RESPECT TO THEIR EFFICIENCY IN INDUCING MUTATIONS IN SILKWORM GONIA. Idengaku Zasshi (Jap. J. Genet.) 40 (1965) 113-24.

An investigation was made of the effects of fission neutrons on the induction of visible recessive mutations in early and in late gonial cells of the silkworm. The results were compared with those of our previous reports, in which 14 MeV neutrons and ^{137}Cs γ-rays were used. Dose-mutation frequency curve for fission neutrons was essentially the same as that for other radiations, showing a slow rise in the lower dose range but a rapid rise in the higher dose range. Mutation response to fission neutrons was almost similar for male and female gonial cells, although higher frequencies were observed for fission neutrons than for γ-rays or 14 MeV neutrons. When radiation doses producing a frequency of 10^{-3} of visible recessive egg-colour mutations were used as a criterion, the relative biological effectiveness of fission neutrons to γ-rays was about 1. 7 to 2. 4 for early stage gonia and 3.0 to 4.2 for late-stage gonia. Similar results have already been reported for 14 MeV neutrons, although the values were smaller. All the dose-frequency curves obtained in the recent series of our work with γ-rays, 14 MeV neutrons and fission neutrons are given in the present paper to make them available for further investigations in this field. (Auth.)

703(2) Murakami, A., Tazima, Y. MODIFICATION OF x-RAY INDUCED MUTATION RATE IN THE SILKWORM BY PRE OR POST IRRADIATION TREATMENT WITH HALOGENATED BASES ANALOGUES. Rep. natn. Inst. Genet., Misima 13 (1962) 89-91.

704 Nickel, E. EFFECTS OF 2, 4-DINITROPHENOL ON THE RADIOINDUCED DOMINANT LETHAL FACTORS IN Drosophila melanogaster. Strahlentherapie 126 (1965) 263-68. (In German)

The influence of 2, 4-dinitrophenol on the radio-induced dominant lethal factors of D. melanogaster was investigated. Administration of DNP by food or by injection to 80- or 96-h-old male larvae 4 h prior to irradiation did not affect the number of the radio-induced dominant lethal factors. Dominant lethal factors produced by irradiation with 1000 R affected predominantly the early embryonic stages. The ineffectiveness of DNP, administered 4 h prior to irradiation, might be explained by a possible dissimilation or by the excretion of DNP. There were anomalies in the testes of adult males irradiated during the larva stage. (Auth.)

705 Nicoletti, B., Olivieri, A., Olivieri, G. FURTHER DATA ON THE INTERACTION BETWEEN ULTRAVIOLET AND IONIZING RADIATIONS ON THE PRODUCTION OF RECESSIVE LETHALS IN Drosophila melanogaster. Atti Ass. genet. ital. 9 (1964) 172-84. (In Italian)

The sex-linked recessive lethal mutation frequency induced by 4000 R of x-rays in mature sperms of D. melanogaster was significantly decreased by a u. v. post-treatment (λ 2537 Å, 3 x 10^6 ergs/cm^2 exposure dose). Use of smaller u. v. doses (1. 8 X 10 ergs/cm^2) did not result in a decrease of the x-ray induced recessive lethals. Spermatozoa and spermatids showed a similar sensitivity to u. v. induction of point mutation recessive lethals in a $X^{C2}yB$ ring chromosome. The possible mechanism through which u. v. radiation determines these effects was examined. (Auth.)

706 Ondrej, M. INFLUENCE OF INTERACTION BETWEEN EDTA AND x-RAYS ON MUTATION AND CROSSOVER FREQUENCIES IN Drosophila melanogaster. p. 26-29 of "Induction Mutations Mutation Process. Proceedings of a Symposium, Prague, 1963". Published 1965.

A whole generation of Suchumi stock was put into a medium containing 2 x 10^{-3}M EDTA. EDTA alone caused 0. 49% lethals, x-rays alone 4. 41%, and the combination of EDTA and x-rays 5. 43%. If EDTA solution was given to 24-48-h-old males, an increased lethal effect was observed during the first days after the administration (9. 57%). The combination of EDTA injection with x-irradiation resulted in lower original values of lethals (4. 7%) with relative constant values even 6 d later. Virgin females were influenced by EDTA and x-rays, either alone or in combination. All types of treatment increased the cross-over frequency. (CA 64:1966, 10061c)

707 Oster, I. I. MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. p. 135 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

708 Oster, I. I. MUTAGENIC EFFECTS OF CHRONICALLY AND INTENSELY DELIVERED RADIATION IN Drosophila. Idengaku Zasshi (Jap. J. Genet.) 40, Suppl.(1965) 83-96.

Results of recent experiments on the effects of varying the dose-rate of γ-radiation in Drosophila are presented and discussed in relation to previous findings and those of others. At the present time no clear-cut evidence for a dose-rate effect in the production of mosaically-expressed and whole-body point changes is available although further work is indicated. The latter would be aimed at ruling out the possibility of complications arising because of differential radiosensitivity masking repair mechanisms. On the other hand, in non-static cells (e. g. those which are more active, metabolically-speaking, and less mature than spermatozoa) processes involving multi-hit phenomena exhibit a distinct dosage dependence. (Auth.)

709 Parfenov, G. P. OCCURRENCE OF CROSSING OVER IN Drosophila MALES UNDER THE INFLUENCE OF VIBRATION, ACCELERATION AND γ-IRRADIATION. Kosm. Issled. 2, 4 (1964) 648-53. (In Russian). English Translation: FTD-TT-64892. Cosmic Res. (1964) 232-41.

The influence of vibration, acceleration, and γ-irradiation on the incidence of crossing-over in Drosophila males is examined. It is customary to assume that this class of hereditary changes is governed by rebuilding of homologous chromosomes in the meiotic stages. This test was also used aboard artificial earth satellites to indicate the biological effect of cosmic radiation, and some results were obtained. To analyse the differences that arose, experiments were run with Drosophila specimens subjected to acceleration, vibrations, γ-irradiation, and combinations of these factors. The data obtained are discussed. (Auth. - NSA 18:1965, 41095)

710 Parkash, O. INDUCTION OF SEX-LINKED RECESSIVE LETHALS AND VISIBLE MUTATIONS BY FEEDING x-IRRADIATED DNA TO Drosophila melanogaster. Nature, Lond. 205 (1965) 312-3.

The radiomimetic effects of DNA irradiation products (DNAm) were studied in D. melanogaster fed on DNA irradiated with 100 000 R radiation. Males emerging from larvae fed DNAm media were tested for sex-linked lethals by Muller's technique before mating with normal females. A number of visible mutations were found in the resultant cultures, in addition to a number of flies with gross morphological abnormalities. No conspicuous visible mutations or flies with morphological abnormalities were detected in cultures produced by flies fed normal DNA. Hence, the mutagenic effect of DNAm was definitely established. Assuming a spontaneous mutation rate of 0.17%, DNAm cultures showed a 32-fold increase over the spontaneous rate, an increase corresponding to a direct exposure of the spermatozoa to about 2000 R of x-ray. (NSA 19:1965, 10910)

711 Parkash, O. ON THE RADIOMIMETIC EFFECT OF IRRADIATED DESOXYRIBONUCLEIC ACID (DNA_m) ON Drosophila melanogaster. Naturwissenschaften 52 (1965) 142.

The mutagenic effect of DNA irradiated with a dose of 100 000 R at a rate of 625 R/min on D. melanogaster was investigated. The males from the larva that had grown on irradiated DNA were tested for the presence of sex-linked recessive lethals. A sex-linked recessive lethal rate of 5. 7% was found, and an autosomal recessive lethal rate of 9. 6%. In addition a number of visible mutations concerning the eye colour, body colour, and body size, abdominal malformation, and wing size and form were also detected. The results showed a 30-fold increase for the sex-linked lethals and 60-fold increase for the autosomal lethals. (NSA 19:1965, 38413)

712(1) Plough, H. H., Ed., Sheppard, C. W., Ed. GENETIC EFFECTS OF FAST NEUTRONS FROM NUCLEAR DETONATIONS. PROJECTS 23. 4-2314 AND 23. 16 OF OPERATION UPSHOT-KNOTHOLE. WT-820, Division of Biology and Medicine (AEC), Washington, D. C. Jan. 1954, 58p.

A series of genetic test objects were exposed to fast neutron irradiation at Upshot-Knothole. Drosophila flies, Mormoniella wasps, and several mouse strains constituted the animal specimens used. The data indicate that the relative biological effectiveness (RBE) for genetic effects from detonation neutrons compared with x- or γ-irradiation is high, observed values ranging from about 2-15 or more. The RBE for chromosome breakage from detonation neutrons is not significantly higher than that from cyclotron neutrons; this conclusion is subject to some uncertainties in dose determination. It is indicated that the RBE for the production of simple mutations by fast neutrons compared with x-rays tends to be low. The values are higher for gross chromosome aberrations. The genetic tests are of some value as biological dosimeters supplementary to physical dosimetry. The studies clearly indicate that for equal doses neutrons represent a greater potential genetic hazard than other forms of radiation from nuclear detonations. (From auth.)

713 Purdom, C. E., Bridges, B. A. EFFECT OF SULPHYDRYL REAGENTS ON THE FREQUENCY OF x-RAY-INDUCED AUTOSOMAL RECESSIVE LETHAL MUTATIONS IN Drosophila melanogaster. Nature, Lond. 203 (1964) 419.

The induction of autosomal recessive lethals in D. melanogaster was studied by the brood analysis technique that tests germ cells irradiated at all stages of maturation. Prior to x-irradiation under anoxic conditions, the animals were injected with saline, saline plus N-ethylmaleimide, (NEM), or iodoacetamide (IA Am). A significantly higher mutation frequency was observed in the group treated with NEM compared to the saline-injected group, but not in the IA Am and saline injected groups. (NSA 18:1964, 36987)

714 Reddi, O. S., Reddy, G. M., Rao, J. J., Ebenezer, D. N., Rao, M. S. LACK OF MUTAGENIC EFFECT OF IRRADIATED *Drosophila* MEDIUM. *Nature*, Lond. *208* (1965) 702.

The basic medium (water, glucose, agar, yeast, propionic acid in the proportions of 100:10:3:10:0.4 in g) was exposed to 150 000 and 300 000 rad of γ-radiation, at 25 000 rad/min. Treated and control bottles were stocked with adult flies of the wild-type *Or-K* strain. When sufficient eggs had been laid the parents were discarded. Subsequent tests on progeny from mating under specified conditions were made for recessive sex-linked lethals and translocations, and for sex-linked visible mutations and large deletions. There appears to be no justification for a claim of genetic effects on *Drosophila* arising from the irradiated medium.

715 Reddi, O. S., Rao, M. S. GENETIC EFFECTS OF COSMIC RADIATION IN *Drosophila melanogaster*. *Nature*, Lond. *201* (1964) 96-7.

Dominant lethality was used as the measure of the genetical effect. 2 to 3-d-old males of the wild-type Oregon-K strain were sent in plastic food cups in a pressurized Al gondola at 8°N geomagnetic latitude to a height of 20 miles into the stratosphere. The compositions of charged particles there is 85% protons, 14% α-particles, and ~1% heavier charged particles, giving a dose of 0.7-0.8 mR/d/unit volume; for a 6-h flight 0.18-0.20 mR/unit volume would thus be received. Soon after descent, one lot of males was tested for dominant lethals in six successive broods of 3 d each, while the other lot was screened for sex-linked recessive lethals and translocations. Dominant lethals were determined by hatchability tests. A dual-purpose tester stock, *y* sc^{SI} *In* 49 sc^{8}; *bw*; *st*, was used. There was no evidence for increased frequency of recessive lethals or translocations but hatchability tests showed a consistent reduction in the first three broods of the treated series, while in the later broods the difference between them and the controls became less significant. The induction of dominant lethals may account for this reduction.

716 Rinehart, R. R. INFLUENCE OF OXYGEN, HELIUM, AND METABOLIC INHIBITION ON x-RAY INDUCED DOMINANT LETHALITY IN STAGE 7 AND STAGE 14 OOCYTES OF *Drosophila melanogaster*. *Genetics* *49* (1964) 855-63.

Experiments designed to test the effects of various O_2-tensions given before, during, and after the x-irradiation of adult females on the survival of stage 7 and stage 14 oocytes support the following conclusions: No significant differences in the relative radiosensitivity between stage 7 and stage 14 oocytes is attributable to differential amounts of intracellular O_2 · Extended He pre- or post-treatment causes a significant increase in x-ray induced dominant lethality in stage 7 oocytes. This increase in lethality is proportional to the duration of anoxia. No such sensitizing effect of helium treatment is observed with the stage 14 cells. The effect of anoxia in increasing dominant lethality is prevented when the flies are given anoxic treatments at 4°C. The effects of anoxic pretreatment are reversed when the cells are allowed to recover in air prior to irradiation. The results are interpretable in terms of a system that repairs chromosome breaks and that is depleted during prolonged anoxia. (Auth. summary)

717 Rinehart, R. R., Ratty, F. J. MUTATION IN *Drosophila melanogaster* CULTURED ON IRRADIATED FOOD. *Genetics* *52*, 6 (1965) 1119-26.

Males and females were cultured on food irradiated with 150, 500, or 3000 kR of x- or γ-rays and offspring were tested for dominant, sex-linked, and F_3 lethality. In some experiments, control and irradiated food was stored for three weeks prior to its use. There was no decrease in F_1 offspring survival associated with culturing on irradiated food. There was an approximate two-fold increase in sex-linked recessive lethality in the 150, 500, and 3000 kR experiments. This increase can be attributed largely to an increase in gonial mutants. Aging the food prior to use resulted in a decrease in nongonial mutation; there is still, however, an effect of the irradiated food in increasing lethality above control levels, which was again associated with gonial mutations. F_3 lethality was not detectably increased whether mosaic, F_1 complete, or total F_3 lethality was considered. (Auth. summary)

718 Schleuss, P. EINFLUSS EINER KÄLTEBEHANDLUNG NACH BESTRAHLUNG AUF DEN AUSFALL DER SETA DORSO-CENTRALIS ANTERIOR BEI *Drosophila melanogaster* "SEVELEN" UND "BERLIN INZUCHT". (Effect of cold treatment post-irradiation on the loss of chaeta dorso-centralis anterior in *Drosophila melanogaster* Sevelen and Berlin inbred). *Strahlentherapie* *123*, 1 (1964) 139-45. (In German)

Phenocopies "loss of the chaeta dorso-centralis anterior" (dca) and "spread wing" were produced by irradiation of 5-h-old pupae with 3000 rad. Differences in sensitivity between the wild strains were observed. Loss of the dca chaetas can also be produced by exposing 5-h-old pupae to cold (2 ± ½°C). Exposure to cold has a radiomimetic effect. An extended cold period of 4 h, post-irradiation, has a protective effect, but the differences obtained with the t-test were not significant. The effects were more or less additive when prolonged for 12 h. After irradiating pupae of different ages (4½-5½ h) an increase in radiation sensitivity could be observed for the modification "spread wings" every 15 min, a decrease for "loss of chaeta dca". The difference in su sensitivity is probably caused by differences in rate of development in the two wild strains.

719 Semerdzhyan, S. P., Nor-Arevyan, N. G., Megroyan, Sh. G. EFFECT OF HIGH OXYGEN PRESSURE ON THE RADIATION EFFECT ON SILKWORM GRANULES. *Izv. Akad. Nauk armyan. SSR* *16*, 11 (1964) 91-94. (In Armenian)

The effect of x-irradiation (1000-1500 R) on silkworm granules of 3rd and 6th generations subjected to ≤50atm of O during irradiation was examined. After x-irradiation the granules were kept at 22°C for 17 d and then the percentage of surviving granules was determined. The high O pressure did not affect granule survival. A small decrease of granule sensitivity to x-ray was marked at 5 and 30 atm of O. The effect of O pressure depended on the x-ray dose. The inhibitor effect of O during irradiation indicated the biological action of x-rays was related to the chain of oxidation reactions. (CA 63:1965, 2169d)

720 Skuratovich, A. A., Pravdina, G. M. FEATURES PECULIAR TO THE BIOLOGICAL ACTION OF ULTRAFRACTIONAL PULSE RADIATION. *Medskaya Radiol.* *10*, 2 (1965) 28-35. (In Russian)

The authors report experiments concerned with studies of the biological action of ultrafractional radiation (four-tube x-ray apparatus with ion contactor on ignitrons). Experiments were performed on the eggs of *Drosophila melanogaster*. Curves of dependence of the biological effect on the dose (from 200 R-1200 R) were obtained. The injurious action of pulse radiations with different pulse-pause ratios is lesser than the biological effect of contiuous radiation with a dose capacity of 1.3 R/sec and higher, and greater than the biological action of continuous irradiation with a dose capacity of 75 R/sec. The dose curves of pulse radiations occupy an intermediate position between the curves of continuous irradiations with dose capacities of 1.3 R/sec and 75 R/sec. The derived differences in the biological effect are explained in connection with the concept on the comparability of the total time of action and the duration of the mitotic cycle of the ovicell of *D. melanogaster*. (Tr-auth.)

721(2) Sobels, F. H. THE EFFECT OF POST-TREATMENT WITH N_2 OR O_2 ON THE FREQUENCIES OF RECESSIVE LETHALS AND TRANSLOCATIONS PRODUCED BY IRRADIATION IN N_2 OR O_2. (Abstr.) *Int. J. Radiat. Biol.* *6*, 5 (1963) 492-3.

The aim of this study was to determine how post-treatment with N_2 and O_2 would affect the repair of pre-mutational damage and the realization of chromosome breaks, induced by x-irradiation in either N_2 or O_2. Male flies, carrying a ring-shaped X-chromosome (X^{C2}*yB*/sc^{8}.Y), were pretreated for 25 min in either N_2 or O_2 and exposed to x-rays in the respective gases (3000 R in N_2 and 1000 R in O_2) at 100 kV, 4 mA, 1 mm Al at 46 R/sec. Subsequently they were post-treated with either N_2 or O_2 for 25 min. The males were mated to females of the genetic constitution *y* sc^{Cl} In 49 sc^{8}; bw; st^{pp} for 5 successive 2-d broods (6 females/male/brood). In this way the induction of sex-linked recessive lethal mutations and translocations between the second and third chromosomes could be followed simultaneously through the successive stages of spermatogenesis with different sensitivities to the mutagenic action of x-rays. If a dose of 3000 R is given under anoxic conditions, post-treatment with O_2 significantly reduces the mutation-frequency in spermatids, in comparison with that found after post-treatment with N_2. This result is interpreted on the assumption that post-treatment with O_2 activates a repair system, which had been effectively inhibited by anoxia preceding and during radiation exposure. A similar result was obtained if, after radiation in N_2, the flies were held anoxic for 25 min and then transferred to an O_2 atmosphere. Fixation of premutational damage in N_2 thus does not seem to occur within 25 min after irradiation. After exposure to 1000 R in O_2, however, the effect of post-treatment with O_2 equalled that of post-treatment with N_2. The same mutation-frequencies were then observed as after exposure to 3000 R in N_2, followed by post-treatment with N_2. Post-treatment with O_2 did not affect the frequency of translocations induced by radiation in N_2, but modified the translocation frequency after irradiation in O_2. The discrepancies between the results for mutations and translocations suggest that the process responsible for repair of pre-mutational damage differs from that involved in the restitution of chromosome breaks or in the conversion of potential breaks to real breaks. (From abstr.)

722 Sobels, F. H. POST-RADIATION REDUCTION OF GENETIC DAMAGE IN MATURE *Drosophila* SPERM BY NITROGEN. *Mutation Res.* *1* (1964) 472-7.

Earlier work showed that post-radiation modification of x-ray damage is strongly influenced by conditions existing at the time of exposure. Thus, when *Drosophila* males are exposed to x-irradiation under anoxia, and the effect of post-treatment with N_2 is compared to that with O_2, the frequency of recessive lethal mutations is reduced by N_2 in sperm, but by O_2 in spermatids and spermatocytes. After irradiation in O_2, however, post-radiation modification was not observed in either stage of spermatogenesis. These findings were interpreted to mean that repair of premutational damage in sperm is favored by N_2, but in spermatids and spermatocytes by O_2, and that radiation in O_2 restricts the capacity to undergo repair. To verify whether the unexpected finding of post-radiation modification in mature sperm had been caused by shifts in the sampling of sperm cells with different radiosensitivities, the experiments were repeated with pure samples of mature sperm irradiated in the inseminated females. In summary, the results show that after irradiation with 4000 R in anoxia, post-treatment with N_2 consistently reduces the mutation frequency; the same was observed for autosomal translocations. After irradiation with 2000 R in O_2, no post-treatment effect was found for lethals, but the frequency of translocations was significantly reduced by post-treatment with N_2. (Auth.)

723 Sobels, F. H. THE ROLE OF OXYGEN IN DETERMINING INITIAL RADIOSENSITIVITY AND POST-RADIATION RECOVERY IN THE SUCCESSIVE STAGES OF *Drosophila* SPERMATOGENESIS. *Mutation Res.* *2* (1965) 168-91.

The role of oxygen in determining radiosensitivity to the induction of premutational damage, and in processes of post-radiation repair was studied in different stages of spermatogenesis by comparing the effect of post-treatment with N_2 to that with O_2 after x-irradiation of *Drosophila* males in either N_2 or O_2. Recessive lethals were scored in a ring-X-chromosome in 4-5 successive 2-d broods. After irradiation in N_2, it was found that post-radiation recovery in sperm is favoured by N_2, but in early spermatids and spermatocytes by O_2. In late spermatids and spermatogonia no significant post-radiation modifications were observed. Post-radiation recovery by N_2 in mature sperm was further confirmed by results obtained from sperm, treated in the inseminated females. The results for early spermatids and spermatocytes indicate that a repair system which has been rendered ineffective by anoxia can be regenerated to normal functioning by post-treatment with O_2. The time of mutation fixation in early spermatids could not be established definitely, but indications were obtained that in N_2 fixation does not occur within 25 min, whereas after 50 min the reversibility of the pre-mutational lesions is strongly decreased. In contrast to the observations after irradiation under anoxia, no post-radiation modification of the mutation frequencies by N_2 or O_2 was found after irradiation in O_2 for sperm, spermatids, or spermatocytes. Only in spermatogonia post-treatment with O_2 lowered the mutation frequency, as compared to that after N_2 post-treatment. It was concluded that radiation in O_2 produces more irreparable damage than radiation in N_2. (NSA 19:1965, 38463)

724 Sollunn, F.-J., Strømnaes, Ø. THE EFFECT OF TEMPERATURE DURING IRRADIATION ON INDUCED MUTATION FREQUENCY IN *Drosophila melanogaster* SPERM. *Hereditas* *51*, 1 (1964) 1-12.

3-d-old males were tested for the induction of dominant lethals and recessive sex-linked lethals in three successive daily broods. The control males were exposed to a temperature of 22°C or 0°C for half an hour. The experimental males were exposed to the same temperatures for the same length of time while they were irradiated with 2500 R of x-rays. There are no significant differences between treatments for either type of lethals in the control series. In the experimental series there are significantly higher frequencies of both types of lethals in the series irradiated at 0°C than at 22°C. For sex-linked lethals at either temperature and for dominant lethals induced at 22°C the first brood has a significantly higher frequency than the second brood. The frequencies of dominant lethals induced at 0°C exhibit no statistically significant difference between the three broods. (Auth. summary)

725 Sollunn, F.-J., Strømnaes, Ø. THE EFFECT OF TEMPERATURE DURING IRRADIATION ON INDUCED MUTATION FREQUENCY IN *Drosophila melanogaster* SPERM. *Hereditas* *51*, 1 (1964) 1-12.

3-d-old male *D. melanogaster* were tested for the induction of dominant lethals and recessive sex-linked lethals in three successive daily broods. The control males were exposed to a temperature of 22°C or 0°C for half an hour. The experimental males were exposed to the same temperatures for the same length of time while they were irradiated with 2500 R doses of x-rays. There were no significant differences between the effects of treatments for either type of lethals in the control series. In the experimental series there were significantly higher frequencies of both types of lethals in flies irradiated at 0°C than at 22°C. For sex-linked lethals at either temperature and for dominant lethals induced at 22°C the first brood had a significantly higher frequency than the second brood. The frequencies of dominant lethals induced at 0°C exhibited no significant difference between the three broods. Presumably the difference in temperature during irradiation is responsible for the observed differences in induced mutation rate. The frequency of dominant lethals increased about 40% when the temperature was lowered from 22°-0°C during irradiation, and the corresponding increase in recessive sex-linked lethals was about 90%. It is suggested that the temperature effect may act primarily on the breakage process and secondarily on the restitution process, or on both. Chemical reactions, which may be involved in the breakage as well as in the restitution processes, might be influenced by temperature changes, or the lowered temperature may change the viscosity within the nucleus, or it may change the stress in the chromosome coiling. To explain these data several other factors which may influence the mutation rate are proposed. Thus changes in oxygen pressure may be partially responsible for the higher frequencies induced at the lower temperature. However, possible inactivation of radioprotective systems at the lower temperature must also be taken into account. The oxygen effect may obscure the effect of protective systems when a comparison is made between temperature treatments within broods. However, a comparison of the frequencies between broods within temperature treatments indicates that radiation protective systems may be active in lowering the induced mutation rate from first to second brood. This conclusion is drawn from the data for the dominant lethal series. That the data for the sex-linked lethals do not exhibit exactly the same picture as for dominant lethals is ascribed to the different nature of the two types of lethals. (NSA 19:1965, 10822)

726 Sugai, E. EFFECT OF TEMPERATURE ON RADIATION INDUCED MALE STERILITY IN THE SILKWORM, *Bombyx mori* L. *Jap. J. appl. Ent. Zool.* *9*, 4 (1965) 266-70. (In Japanese, with English summary)

Post-irradiation temperature had a marked effect on male fertility. It was most noticeable at 48 h post irradiation when 30°C gave the highest percentage of unfertilized eggs, with a lower value obtained for 24°C, and an even lower value for 18°C. Cytological analysis showed spermatogonia to be most radiosensitive, and most liable to radiation killing; radiation-induced sterility, however, was determined by the state of the spermatocytes at the time of exposure. A 2000 R-dose (100 R/min) of γ-radiation from a ^{137}Cs source was given.

727(1) Tazima, Y. RADIATION MUTAGENESIS IN THE SILKWORM. IV. INDEPENDENCE OF RADIATION INTENSITY AS SHOWN BY INDUCED STERILITY OF SPERMATOGENIC CELLS. *Rep. natn. Inst. Genet.*, Misima *9* (1958) 98-99.

728(2) Tazima, Y., Onimaru, K. INDEPENDENCE OF INDUCED MUTATION-RATE FROM RADIATION DOSE RATE IN THE GERM CELLS OF HIBERNATING SILKWORM EMBRYO. *Rep. natn. Inst. Genet.*, Misima *14* (1963) 98-99.

729(2) Tazima, Y., Murakami, A. ENHANCEMENT OF RADIATION INDUCED MUTATION FREQUENCY BY POST TREATMENT OF SILKWORM GONIA WITH 5 BROMODEOXYURIDINE. *Rep. natn. Inst. Genet.*, Misima *14* (1963) 100.

730 Tazima, Y. CONTRIBUTION FROM 14 MeV NEUTRON EXPERIMENTS TO THE INTERPRETATION OF THE MECHANISMS OF DOSE-RATE EFFECTS ON MUTATION FREQUENCY IN SILKWORM GONIA *Idengaku Zasshi* (Jap. J. Genet.) *39* (1964) 115-19.

Results are summarized from a series of studies on the mechanisms of dose-rate effects on mutation frequency in silkworm gonia. Data are reported on the effects of chronic and acute exposure to various doses of x-rays, γ-rays, and 14 MeV-neutrons on mutation frequencies induced by exposure at different larval stages. (NSA 19:1965, 21916)

731 Tazima, Y. MECHANISMS CONTROLLING TWO TYPES OF DOSE-RATE DEPENDENCE OF RADIATION-INDUCED MUTATION FREQUENCIES IN SILKWORM GONIA. Idengaku Zasshi (Jap. J. Genet.) 40, Suppl. (1965) 68-82.

As far as x- and γ-rays are concerned, the mutational response of young germ cells, mostly gonial stages, of the silkworm is not simple. At least two types of dose-rate dependence, with one being the reverse of the other, have been found in this insect. In one type the mutagenic effectiveness of chronic irradiation (0.1 R/min) is lower than that of acute irradiation (100 to 300 R/min) and in the other, mutagenic effectiveness is higher for chronic irradiation than for acute irradiation (Type II). Which type appears is solely dependent upon the developmental stage of the irradiated larva. Irradiation of newly hatched larva results in a Type I dose-rate dependence while irradiation at a later stage, around the time when the larvae are 8 d old, gives completely reverse results. The complexity in the dose-rate effect is entirely due to a drastic change in mutagenic effectiveness of acute irradiation in accordance with the developmental stage. The dose-mutation frequency curve shows the highest peak at hatching time but decreases rapidly thereafter. In contrast, the mutagenic effectiveness of chronic irradiation remains almost the same. In order to interpret the reverse type of dose-rate effect, a hypothesis involving selective cell killing was proposed. The hypothesis was based on the finding that the homogeneous germ cell population which is present at hatching time becomes gradually heterogeneous with the development of the larva and gonial cells at an advanced stage are highly sensitive to cell killing by radiation. It was also assumed that cell killing is more drastic for the accute than for the chronic exposure and that the cells sensitive to killing are also sensitive to having mutations induced in them. However, cytological evidence to support this hypothesis was not obtained. Secondly, a differential repopulation hypothesis was proposed but this was again found to be unsatisfactory. The dose-fractionation experiments, however, yielded very suggestive information for the interpretation of the dose-rate effect. When 1000 R acute irradiation was delivered in two fractions, 500 R + 500 R, separated by various time intervals from 2-48h, a remarkable increase in mutation frequency was observed throughout the period examined, showing a peak if the second dose was given 12 or 24 h after the initial exposure. A new hypothesis is proposed for the interpretation of the complicated features of the dose-rate effect as follows: a large part of the radiation-induced premutational damage is repaired during the post-irradiation recovery process; the degree and extent of repair primarily depends upon the total dose and dose rate; the occurrence of repair also largely depends upon cellular conditions, presumably metabolic activity, of the irradiated cell; and the final magnitude of the observed mutation frequency is determined by both factors in combination. (From auth.)

732(2) Tazima, Y., Murakami, A. THE INCREASE IN INDUCED MUTATION FREQUENCY AFTER FRACTIONATED IRRADIATION OF GONIAL CELLS OF THE SILKWORM. Rep. natn. Inst. Genet., Misima 13 (1962) 87-9.

Silkworms were given single and fractionated 1000 R x-ray doses. Mutation frequency was estimated during the early larval stage from the 7th - 9th day after hatching by the specific locus method of pe and re loci. Higher mutation frequencies were found in groups given fractionated irradiation than in the single shot groups. Results also suggest that fractionated irradiation with 24-h intervals between fractions is more effective than with 48-h intervals. However, interval shortening proved to have a limit. (NSA 18:1964, 31143)

733(2) Tazima, Y., Onimaru, K. FURTHER REPORT IN THE INCREASE OF INDUCED MUTATION FREQUENCY AFTER FRACTIONATED IRRADIATION OF GONIAL CELLS OF THE SILKWORM. Rep. natn. Inst. Genet., Misima 14 (1963) 97-98.

734 Trosko, J. E. ANALYSIS OF POSTIRRADIATION MODIFICATION OF GENETIC DAMAGE IN MATURE Drosophila melanogaster SPERM. Diss. Abstr. 25, 2 (1964) 769.

This study was conducted to elucidate the recovery phenomenon which is reported to be associated with post-irradiation modification of the genetic damage in mature Drosophila spermatozoa. In order to distinguish between differential sensitivity or other post-irradiation phenomena, the possible modifying effect of several variables was analysed. Variables such as storage of sperm in males and females, cold temperature, physiological condition of the females, and sperm loss were utilized. Sex-linked lethal mutation rate, egg-hatch and counts of total progeny were used to measure the damage in irradiated mature Drosophila spermatozoa. Comparisons of these measured criteria were made between sperm, either non-aged or aged under experimental conditions. The results indicate that neither aging for 2 weeks nor cold temperature of 10°C changed the sex-linked mutation rate when the irradiated sperm were stored in the females. Pre-aging the females on minimal medium at room temperature prior to mating increased the frequency of detected sex-linked lethals. Although lower rates of biological damages were observed in the second sperm batch than in the first sperm batch of all irradiated males, the difference between the two sperm batches was smaller for the males stored at room temperature than non-stored or cold-stored males. The damage associated with the first sperm batch of cold-stored irradiated males was not different from that of the first sperm batch of non-stored irradiated males. These latter two observations were interpreted to indicate that mixing of sperm, rather than recovery, occurred in males stored at room temperature prior to mating. This explanation demands that the sperm population at the time of irradiation be heterogeneous and compartmentalized with respect to radiation sensitivity. The cold temperature storage did not significantly modify the measured damage. However, it was observed after comparing the results of the sex-linked and dominant lethal studies that the cold temperature post-treatment of the irradiated males may have increased the recovery of sex-linked lethals while decreasing the frequency of dominant lethals. (DA)

735 Trosko, J. E. EFFECT ON GENETIC DAMAGE OF POST TREATMENTS GIVEN x-RAYED Drosophila MALES. Genetics 49, 3 (1964) 401-9.

An increase in sex-linked lethal mutation rate after cold storage of irradiated sperm was noted when non-irradiated females were starved prior and subsequent to mating. Cold and aging during the storage of the irradiated sperm did not, per se, contribute to the increase of lethals. Evidence from post-irradiation storage of the male does not support a hypothesis for a recovery mechanism occurring in the sperm. The data are interpreted to indicate that the population of sperm at the time of irradiation is heterogeneous and compartmentalized with respect to radiation sensitivity, and that mixing of sperm can occur in the testes during post-irradiation storage. (Auth.)

736 Vatti, K. V., Yanoosh, I. M. INDUCED MUTATION PROCESS — THE EFFECT OF HIGH TEMPERATURE AFTER IRRADIATION ON THE FREQUENCY OF OCCURRENCE OF LETHAL MUTATIONS AND CHROMOSOMAL BREAKS. p. 29-43 "Studies in Genetics". JPRS-31514. 115p. Translation: Issled. Genet. 2 (1964) 46-55.

The consecutive action of high temperature (+37°C) within 1 h after irradiation of Drosophila larvae with x-rays in a dosage of 100 R causes potential chromosomal injuries and sharply increases the frequency of lethal mutations (2.3 times) in comparison with their sum under the action of temperature and x-rays separately. The relative amount of potential damage exceeds by 1.53 times the number of actual lethal mutations. Under the conditions of a high spontaneous level of chromosomal breaks x-rays in the same dosage of 100 R do not cause actual breaks, producing only potential chromosomal breaks caused by high temperature. Their ralative amount is equal to 0.73. The facts which have been derived emphasize that the state of the after-effect of low radiation dosages is characteristic both for lethal mutations and for chromosomal aberrations. The after-effect is hypothetically explained by the presence of both potential chromosomal injuries as well as their high capacity for closing the initial breaks. (NSA 20:1966, 3713)

See also:

27 Mutations in Drosophila melanogaster grown on media containing carbon-14 labelled sugars. (Suomalainen, E. et al., 1956)
505 Biological studies. (Japan. National Inst. of Radiological Sciences, Chiba,, 1964)
507 Variation in mutagenicity and radiation resistance with genome complexity and evolution. (Kondo, S., 1964)
528 Dose rate effects in the developing germ cells of male Drosophila. (Alexander, M. L., Bergendahl, J., 1964)
530 Grasshopper neuroblast techniques. (Carlson, J. G., Gaulden, M. E., 1964)
552 The relation of the composition of the culture medium to mitotic activity and to x-ray induced mitotic inhibition in the neuroblast of the grasshopper, Chortophaga viridifasciata (de Geer). (Shaw, E. I., 1955)
540 Influence of tonicity on mitotic recovery in x-irradiated grasshopper neuroblasts. (Meisner, H. M., 1964)
541 Influence of tonicity on mitotic recovery in x-irradiated grasshopper neuroblasts. (Meisner, H. M., 1965)

553 Radiosensitivity and repair in different germ cell stages of *Drosophila.* (Sobels, F.H., 1965)

575 Interaction of chromosome breaks in the spermatozoa of *Drosophila* induced by x rays and fast neutrons. (Reddi, O. S., 1964)

583 The dose-dependence of X-chromosome loss and non-disjunction induced by x-rays in oocytes of *Drosophila melanogaster.* (Traut, H., 1964)

584 Dependence of frequency of occurrence of phenocopies on x-ray dose. (Volchkov, Yu. A., Aleksandrov, Yu. N., 1963)

603 Recession. The effect of level of feeding on the frequency of x-ray induced sex linked lethal in *D. melanogaster.* (Kishin, A. F., 1964)

608 The relationship between radiation dose and mutation frequency in spermatogonia of *Drosophila melanogaster.* (McSheehy, T. W., 1964)

636 Dominant lethal proportions modified by x-radiation, temperatures, and cohabitation in single- and mixed-species populations of flour beetles, *Tribolium confusum* and *T. castaneum.* (Erdman, H. E., 1964)

639 Gamma radiation and the reproductive behaviour of male *Rhodnius prolixus.* (Gomez-Numez, J. C. et al., 1964)

650 The development of dominant lethality in fruit flies exposed to vibration, acceleration, and gamma radiation. (Parfenov, G. P., 1965)

663 Physiologic factors determining in the formation of melanotic tumors in *Drosophila* (*D. melanogaster*). Influence of heat and irradiation. (Ghélélovitch, S., 1963)

751 Mutations induced by alkylating agents, x-rays and combined treatments. (Mazar-Barnett, B. K. de, 1965)

753 Mutagenic action of mitomycin C on *Drosophila melanogaster.* (Mukherjee, R., 1965)

882 Radiobiologic studies with *Drosophila.* (Baxter, R. C., 1964)

919 Fast-neutron effects on productivity of young and old flour beetles, *Tribolium castaneum* Herbst, and alterations at different temperatures and after exposure of either or both sexes. (Erdman, H. E., 1965)

920 Fast neutron effects on flour beetles. (Erdman, H. E., 1964)

921 Fast neutron effects on productivity of young and old flour beetles, *Tribolium castaneum* Herbst and alterations due to temperature and sex exposed. (Erdman, H. E., 1964)

923 Reproductive performance of x-rayed single-species and mixed-species cultures of *Tribolium confusum* and *T. castaneum* reared at different temperatures. (Erdman, H. E., 1964)

946 Research in genetics to include (1) the direct and indirect effects of radiations and their modification on genetic systems, and (2) population and evolutionary studies of *Drosophila.* (Stone, W. S., 1964)

959 Effects of radiation on competitive insects. (Erdman, H. E., 1964)

10. Comparative Studies
(Radiation. Mutagenic Chemicals. Physical Factors)

737 Alexander, M.L., Glanges, E. GENETIC DAMAGE INDUCED BY ETHYLENIMINE. *Proc.natn. Acad.Sci.*USA *53* (1965) 282-8.

1-d-old males of *Drosophila melanogaster* were injected with a 10^{-2} M solution of ethylenimine. Ethylenimine is a powerful mutagen, but differs from both x-rays and other wellknown chemical mutagens in some characteristics. It resembles x-rays in producing chromosomal abnormalities since translocations are nearly as frequent as sex-linked lethals. Other chemical mutagens do not produce such a high proportion of rearrangements. It resembles chemicalmutagens, such as the mustards, in producing delayed lethals and translocations which appear in the F_2 generation from F_1's that appeared normal. The distribution of sex-linked lethals in the spermatogenic cycle is like that of x-rays. The distribution of F_2 or delayed lethals is different. A majority was recovered from progeny of germ cells which were most nearly mature (mature sperm, late spermatids). In contrast to the delayed mutations and to direct mutations produced by other agents, the frequency of autosomal (second chromosome) lethals was very high for all stages of germ cells. The rate averaged 19.75% for all stages (A-E, sperm to spermatogonia) as compared to 0.86% for sex-linked lethals obtained in the same irradiation test from the same irradiated parents. This major difference exists despite the fact that the autosome is only about twice as long with approximately twice the number of gene loci as the X-chromosome. This demonstrates that mutation production may be grossly miscalculated if based only on the sex-linked mutations detected. The same treated males show three mutation cycles—depending upon whether one tests sex-linked recessive lethals, autosomal recessive lethals, or delayed sex-linked recessive lethals. The appearance of delayed translocations restricts the way such delayed mutations occur. (Auth.)

738 Altenburg, E., Browning, L.S. THE RATE OF GONADAL MOSAICISM FOR LETHALS IN LATE BROODS OF *Drosophila* AS COMPARED WITH EARLY WHEN INDUCED BY x-RAYS, AZASERINE AND QUINACRINE MUSTARD. *Genetics 50*, 2 (1964) 232. Abstr.

Males of Muller's Maxy stock were treated with x-rays in one series of experiments, azaserine in a second, and quinacrine mustard in a third, and the F_1 females were tested for lethals, both whole-body and gonadal mosaic, in early and in late broods derived from 3-d broodings of the treated males. Germ cells used in the first three broods were probably in postmeiotic stages at the time of treatment and those used in the fifth and later broods were probably derived from germ cells which were in premeiotic stages at the time of treatment, though of course the earliest brood in which sperm cells derived from premeiotically treated stages are used would depend partly on how frequently a male mated. However, only fertile broods derived from single males (mated to fresh females) were scored as broodings and therefore a brood represents at least one mating. In the case of all three series of experiments, the percent of mosaicism among the lethals underwent a reduction in the later broods, as follows (the figure for broods 1-5 is given first after each agent, and that for broods 7 and later next): x-rays, 45-9; azaserine, 80-47; quinacrine 85-62. (The two chemical series are still in progress and are about half as large numerically as the x-ray series at present). In the case of x-rays the results are not unexpected, since delayed effects are not usually ascribed to this agent. However, the greatly lowered rate of mosaicism among the chemically induced lethals in the later broods indicates that an appreciable amount of the mosaicism they induce is not due to delayed effects (which are regarded as distinctive of chemical mutagens) but to fractionals, when sperm are treated. (From abstr.)

739 Bateman, A.J., Chandley, A.C. THE SENSITIVITY OF THE MALE GERM CELLS OF *Drosophila* TO METHYL METHANESULPHONATE. *Heredity 19*, 4 (1964) 711-18.

Newly emerged ♂♂ of *D. melanogaster* were injected intra-abdominally with methyl methanesulphonate (MMS) in saline in doses of from 0.25 to 1.5×10^{-4} mg in a constant volume of 0.092 µl. They were then mated daily to two Muller-5-♀♀ for sex-linked lethals and to two wild type ♀♀ for egg-hatchability. Matings for the first 6 d after injection had a constant yield of sex-linked lethals; 8.78% for 1.5×10^{-4} mg MMS and proportionately less at lower doses. Hence sperm and spermatids show equal sensitivity to MMS. A period of sterility followed, ranging in duration from 1-3 d according to dose (spermatocytes). This was followed again by a mutation rate 1/4 of that for the first 6 d (spermatogonia). Egg hatchability (following treatment of sperm and spermatids) indicated that, relative to x-rays, MMS is more mutagenic for point mutations than for chromosome breakage (dominant lethals). The depression of hatchability after the highest dose 11.5×10^{-4} mg MMS) is interpreted as physiological rather than genetical. (BA 46;1965, 55358)

740 Borstel, R.C. von RECENT DEVELOPMENTS IN RESEARCH ON RADIATION AND CHEMICAL MUTAGEN EFFECTS IN INSECTS. ORNL-P-388, Oak Ridge National Lab., Tenn. 20 Aug. 1964, 9p.

A model is presented which provides a reasonable explanation for most of the parameters associated with dominant lethality induced in sperm and an inherent explanation of the radioresistance observed in Lepidoptera sperm.

741 Caspari, E.W. SOMATIC MUTATIONS IN THE MOTH *Ephestia*. December 1, 1961-August 1, 1964. TID-21097, Rochester, N.Y.Univ. nd, 64p.

Each scale of the hind wing of the moth *Anagasta* (*Ephestia*) is a single highly differentiated cell and normal variations are easily recognized. This system was used in studies of somatic mutations induced by x-radiation, 5-bromodeoxyuridine (BUD), or 5- fluorouracil (FU) applied to larvae 8 d after the last larvae molt. Some studies were also made on the development of the eye pigmentary system in the treated larvae and the role of DNA and RNA in the development of this system. Scale aberrations induced by BDU and x-radiation showed considerable differences. Pupae treated with FU survived up to hatching time but their development was inhibited and eye pigment formation was affected. Methods are described by which relatively pure, double stranded, high molecular DNA was extracted from Ephestia larvae, pupae, and adults. Injection of DNA into larvae resulted in block scales with a frequency that indicated they were transformed cells. (NSA 18:1964, 41090)

742 Caspari, E.W., Muth, W., Pohley, H.-J. EFFECTS OF DNA BASE ANALOGUES ON THE SCALES OF THE WING OF Ephestia. Genetics 51 (1965) 771-94.

Ephestia larvae were treated with 5-bromodeoxyuridine (BDU) by injection of solutions of different concentrations 8 d after the last larval moult. Survival was high and no evidence for delay in development was found. BDU was therefore regarded as non-toxic for Ephestia. On the hind wings of treated animals, individual abnormal scales were found. They occur as single, abnormal scales or as homogeneous or heterogeneous clusters. These clusters are regarded as due to the same mutational event. The number of abnormal scales per wing increased in the range from 1-5 µg BDU/animal. At higher levels it reached a plateau at an average of 12 mutational events on a wing containing about 6.250 scales (about 2×10^{-3}). The scale abnormalities induced by BDU differed from those induced by x-rays in several ways. A lack of large clusters of aberrant scales induced by BDU may be explained by an inhibition of growth caused by the drug. The wings of animals treated with high concentrations of BDU (20 µg and over) were significantly smaller than those of controls injected with water. The induction of abnormal scales by BDU was suppressed by equimolar amounts of thymidine. The nature of the BDU-induced abnormal scales is discussed. On the basis of the evidence it is impossible to decide whether they represent point mutations, chromosome rearrangements, or genetically non-transmissible changes. The evidence seems to indicate, however, that more than one mechanism is involved. (NSA 19:1965, 24291)

743 Fahmy, O.G., Fahmy, M.J. DIFFERENTIAL INDUCTION OF CHROMOSOME DELETIONS BY NATURAL AND SYNTHETIC MACROMOLECULES IN Drosophila melanogaster. Genetics 52, 5 (1965) 861-73.

The Minute phenotypes induced by natural and synthetic macromolecules in wild-type (Oregon K) D. melanogaster were classified according to phenotypic expression and analysed for genetic position and physical nature in the salivary gland chromosomes. The proportion of severe Minute phenotypes (due to a deletion on the IV chromosome) was highest with deoxyribonucleoprotein, RNA, and DNA, intermediate with polyadenylic acid and histones, and lowest with some albumins and globulins and polymethacrylic acid. The same mutations in comparable (γ-) radiation experiments occurred at a frequency equal to the minimal level with macromolecules. Mutagenicity might be a manifestation of the specific chemical structure of nucleoproteins and nucleic acids. (CA 64:1966, 2477-de)

744 Fahmy, O.G., Fahmy, M.F. MUTAGENESIS IN RELATION TO GENETIC HAZARDS IN MAN. Proc.R.Soc.Med. 57 (1964) 646-50.

Experimental data are used as a basis for assessing the comparative genetic hazards to man of mutagenic chemicals and ionizing radiations. The mutagenic activity of alkylating compounds was compared to that of radiation on the basis of the efficiency of both classes of agents in the induction of sex-linked recessive lethals in the fruit fly. A standard volume (0.3 µl/fly) of a given drug concentration (usually about 10^{-2}M) was injected into the haemocoel of males (200 to 500 per test) around the testes, and their sperm was then tested for sex-linked recessive lethals. Comparable males were exposed to a measured dose of radiation and their progeny also scored for the same mutations. It was thus possible to determine the concentration of the injected compound which induced the same mutation rate as a given dose of radiation. This analysis revealed that all the alkylating compounds tested were mutagenic to various degrees. The highest mutagenicity occurred with triethylenemelamine which at a concentration of 4×10^{-4}M induced a mutation rate equivalent to 6000 R, while the lowest activity occurred with ethylene oxide which at a concentration of 10^{-2}M induced a mutation rate equivalent to about 30 R. Results are discussed in detail. The distribution of the hot spots (loci of high mutability) was very different for the various mutagens, thus demonstrating the significance of gene/mutagen interaction to the mutational process. Some aspects of the mutation load in man and the concept doubling dose are discussed in terms of these experimental results. A table shows the physical doses of various chemical compounds which are mutagenically equivalent to the total exposure to radiation over a full reproductive generation (as well as to the estimated human doubling dose (35 R)). Hazards associated with the use of these compounds (for example, as drugs and insecticides) are discussed.

745 Gershenson, S. INDUCTION OF LETHAL MUTATIONS IN Drosophila melanogaster BY DNA. Genet.Res. 6 (1965) 157-62.

Addition to the food of Drosophila larvae of DNA from calf thymus induced a considerable number of recessive lethal mutations in the second chromosome. An analysis of 66 such lethals showed that most of them affect the same segment containing probably some 30-35 sub-units capable of mutating together or separately. Results were compared with those from x-irradiating second chromosomes (500 R doses). (NSA 19:1965, 45876)

746 Henke, H., Höhne, G., Künkel, H.A. ÜBER DIE MUTAGENE WIRKUNG VON RÖNTGEN-STRAHLEN, N-NITROSO-N-METHYLURETHAN UND N-NITROSO-MORPHOLIN BEI Drosophila melanogaster. (On the mutagenic effects of x-radiation, N-nitroso-N-methyl-urethan, and N-nitroso-morpholine in Drosophila melanogaster). Biophysik 1 (1963/64) 418-21. (In German)

The mutagenic effects of N-nitroso-N-methylurethan and N-nitroso-morpholine were compared with those of x-rays on D. melanogaster. Lethal factors as well as II/III translocations were determined by the hybridization method. Mutation rates for lethal factors were 0.60% in the controls, 7.92% in irradiated, 2.52% in N-nitroso-N-methyl-urethan-treated, and 2.17% in N-nitroso-morpholine-treated Drosophila. Mutation rates for translocations were 0, 2.94, 0.18, and 0.11%, respectively. (NSA 18:1964, 27097)

747 Henke, H., Höhne, G., Künkel, H.A., Trams, A. THE DIFFERENTIAL MUTATION EFFECT OF CERTAIN CARCINOGENS. Arch.Gynaek. 202, 1 (1965) 475-79. (In German)

Intra-abdominal application of 0.2% N-nitroso-N-methylurethan, 1% N-nitrosomorpholine, and 1% N,N'-bis-(nitrosopiperazine) caused gentic translocations in greater number than irradiation in Drosophila melanogaster. The recessive, sex-linked changes were lethal at a lower rate than radiation changes. The compounds are all known carcinogens. Escherichia coli mutants induced by radiation were mostly of the serine-glycine type; N-nitroso-N-methylurethan application induced many other mutants, some of which had not appeared after irradiation. (CA 63:1965, 10372h)

748 Henneberry, T.J., McGovern, W.L., Smith, F.F. SOME EFFECTS OF GAMMA RADIATION AND A CHEMOSTERILANT ON THE MEXICAN BEAN BEETLE. J.econ.Ent. 57, 6 (1964) 813-5.

Gamma radiation or the alkylating agent apholate sterilized male and female Mexican bean beetle, Epilachna varivestis Mulsant. With adults the effect was produced with ionizing radiation at 8 or 16 kR. Pupae were more susceptible - complete sterilization of females was obtained at doses of 1, 4, 8, or 16 kR and males were sterilized at doses of 4, 8, or 16 kR. Larvae were more susceptible to direct radiation effects than pupae and pupae more susceptible than adults. Adult male or female bean beetles dipped in an aqueous solution of 0.5% apholate or confined for 48 h on bean foliage sprayed with the same concentration in water were completely sterilized. Untreated female beetles mated with treated males (irradiated or exposed to apholate at effective doses) deposited about the same number of eggs as females of untreated pairs, but no eggs hatched. Treated female beetles (irradiated or exposed to apholate at effective doses) mated with untreated males deposited few or no eggs. Adult beetles of either sex irradiated in the pupal or adult stage or apholate-treated adults were shorter lived than untreated beetles. Untreated female beetles mated first with irradiated or apholate-treated males produced sterile eggs, but a subsequent mating with untreated males resulted in the production of viable eggs. (Auth.)

749 Keiser, I., Steiner, L.F., Kamasaki, H. EFFECT OF CHEMOSTERILANTS AGAINST THE ORIENTAL FRUIT FLY, MELON FLY, AND MEDITERRANEAN FRUIT FLY. J.econ.Ent. 58, 4 (1965) 682-5.

In tests conducted in Hawaii from 1959-1964 both sexes of one or more of three species of tephritid flies were sterilized without toxic effects by treating food and water with tepa, metepa, apholate, or tretamine, applying these materials topically to pupae or adults, or exposing adults to deposits of the chemosterilants. Methotrexate, aminopterin, colchicine, and 5-fluorouracil treatments sterilized females only. Tepa, apholate, and tretamine sterilized as effectively and efficiently as ionizing radiation. Tepa showed promise for field applications in combination with attractive protein hydrolyzates. In general, males were sterilized at lower concentrations than females; the melon fly, Dacus cucurbitae Coquillett, was the most susceptible; the oriental fruit fly, D. dorsalis Hendel, intermediate; and the Mediterranean fruit fly, Ceratitis capitata (Wiedemann), the least susceptible to test materials. Treatments were most effective against newly emerged flies, but deposition of hatchable eggs in old gravid fertile females was inhibited within 24-48 h after treatment. In ratio tests mating effectiveness of irradiated and chemically sterilized fruit flies was compared. In one representative test, oriental fruit flies that had received 10 000 R of γ-radiation in the pupal stage 2 d before emergence, and newly emerged flies that had been exposed to 0.1% of tepa in the drinking water for 3 d were matched with different ratios of normal flies. Flies were sexed on the 3 rd d (before sexual maturity) and crossmated the following day at 5:1, 10:1, 15:1, 20:1, and 30:1 ratios of treated to untreated flies. Equal numbers of each sex were used for both treated and untreated flies, with a total of 300 adults at each of the six ratios. Results showed that the two sterilization methods were similar in effectiveness. The 20:1 ratio gave nearly complete suppression in one generation. Results with 10:1 and 15:1 ratios were variable. Microscopically, gonads of chemosterilized and radiation-sterilized flies are alike. Both spermatogonia and spermatocytes are destroyed as in irradiated testes. Spermatids beyond the last division continue to develop, however, and become mature spermatozoa. If some spermatogonia escape destruction, recovery, partial or complete, may take place. In female fruit flies, both irradiated and chemosterilized, ovaries do not develop if flies are treated before the onset of sexual maturity.

750(1) Keyl, H.-G., Werth, G. STRUKTURVERÄNDERUNGEN AN CHROMOSOMEN DURCH MALACHITGRÜN. (Structural changes in chromosomes induced by malachite green). Naturwissenschaften 46, 14 (1959) 453-54. (In German)

Growing salivary gland nuclei of larvae of Chironomus thummi were tested with malachite green. Effects on development and in terms of chromosome breakage and recovery were examined. It was characteristic that, although cells and cell nuclei of a particular gland might be affected differently, the chromosomes of any one nucleus were affected similarly. Breakage observed in the chromosomes was of the same type as the kind produced by x-rays in 24-h-old larvae, and can be considered as genuine mutations. Other structural changes such as constrictions resulting from malachite green treatment are discussed.

751 Mazar-Barnett, B.K. de MUTATIONS INDUCED BY ALKYLATING AGENTS, x-RAYS AND COMBINED TREATMENTS. Genetics 52, 2, Pt.2 (1965) 459. Abstr.

It was considered of interest to establish a comparison of the mutagenic effects of alkylating compounds, x-rays and combinations of the chemicals and radiation. A nitrogen mustard (NITROMIN) and a polyethyleneimine (THIO TEPA) were chosen as representative of two different groups of alkylating agents. Two series of experiments were carried out to determine the frequencies of sex-linked recessive lethal mutations induced in Drosophila melanogaster, one in mature and nearly mature oocytes, the other in mature sperm. The chemicals were injected intra-abdominally in 0.4% saline solution. The irradiation dose (800 R in all cases) was administered in the combined treatments at different intervals: pre-treatment 12 h prior to injection and post-treatments 30 min or 20 h after the injection. The results obtained show (1) that THIO TEPA has a more pronounced mutagenic effect than NITROMIN in both males and females. (2) The effect of combined treatments is at least additive with the nitrogen mustard, but not with the polyethyleneimine, with which no combined treatment has induced a recessive lethal frequency as high as that induced by the chemical alone. (3) Mature sperm shows a much higher sensitivity to all treatments than oocytes, but the relative mutation rates for the different treatments are about the same for both. Thus different interactions of the two chemicals with cytoplasmic constituents and/or x-ray products cannot explain the different mutation frequencies observed. These could be ascribed to different actions of the chemicals on DNA and/or interactions with x-ray products. (Abstr.)

752 Morgan, P.B., LaBrecque, G.C. STUDIES OF THE EFFECT OF MEAT EXPOSED TO GAMMA RADIATION OR CHEMOSTERILANTS ON THE REPRODUCTIVE CAPACITY OF A BLOW FLY Phaenicia cuprina (Wiedemann). Fla Ent. 47, 1 (1964) 31-33.

Raw beef irradiated with 5, 25, and 50 Mrad of γ-radiation from ^{60}Co had no effect on the development, egg deposition, percent hatch, or appearance of P, F_1, and F_2 generations of blowflies, P. cuprina, reared in the meat or allowed to feed on it in the adult stage. Egg production and fertility were affected when adults were fed meat treated with 1% and 0.5% of apholate and 0.5% and 0.25% of metepa. When the larval medium was treated with 0.1% of apholate, larval development was prolonged and did not progress beyond the pupal stage. A 0.05% concentration of metapa in the larval medium slightly extended the period of larval development but did not prevent development to the adult stage. (Auth.)

753 Mukherjee, R. MUTAGENIC ACTION OF MITOMYCIN C ON Drosophila melanogaster. Genetica 51 (1965) 947-51.

Oregon-R males were treated in the following ways: mitomycin C (100 μg/ml); 0.7 N NaCl; mitomycin C (100 μg/ml) and γ-rays; and 0.7 N NaCl and γ-rays. Each treated male was tested for induced sex-linked recessive lethal mutations by the Muller-5 technique for eight successive daily broods. Mitomycin C is mutagenic in all cell stages in Drosophila, with a peak mutation frequency of 5.0% occurring in the third brood. The γ-ray series reached a peak of 5.8% in the fifth brood. Additivity of effect upon combined Mitomycin C and γ-ray treatment was not always indicated, significant decreases occurring in Broods 3 and 6 and an increase in Brood 8. (Auth.)

754 Nakanishi, Y.H., Makino, S. PHASE CINEMATOGRAPHY STUDIES ON THE EFFECTS OF RADIATION AND OF SOME CHEMICALS ON CELLS AND CHROMOSOMES. Int.Soc.Cell Biol. Symp. 3 (1964) 47-62.

Includes effects of ultraviolet rays on Bombyx mori and effects of β-rays on the grasshopper Podisma sapporense. (BAg 29;1965, 101311)

755 Nakao, Y. COMPARISONS BETWEEN MUTAGENIC AND CELL-KILLING EFFECTS INDUCED BY RADIATION AND RADIOMIMETIC SUBSTANCES. Idengaku Zasshi (Jap.J.Genet.) 40, Suppl. (1965) 107-18.

The mutagenic and cell-killing effects induced by x-rays and by chemical mutagens were compared using sex-linked recessive lethal mutation in Drosophila and visible mutation (egg colour mutants) detected by specific locus method in the silkworm. In the case of the induction of lethals and translocations by ethylenimine in Drosophila spermatozoa, we have noticed the production of high degree of sterility. And when we compared mutation and translocation frequencies between two groups which showed high and low sterility, we found the existence of parallelism between lethal or translocation frequencies and sterility. In the case of x-ray induced lethal mutations in Drosophila, there was no sign of correlation between mutation frequencies and sterility, even when x-ray doses were so high as to produce only a few progeny. There were also no apparent correlations between mutation frequencies and the number of eggs laid, between mutation frequencies and hatchability, and mutation frequencies and the percentages of dead eggs in the early developmental stages in the silkworm, when male moths were x-irradiated with the dose of 2 kR. The circumstances were the same as before even when the male moths were irradiated with fairly high dose of x-rays (10 kR). When the female moths were irradiated with high dose of x-rays (10 kR) (and in this case the lethality amongst eggs was very high), we could not find any difference in the mutation frequencies between two groups which have comparatively high hatchability, and those which have low hatchability. The patterns of induction were compared between mutation and lethals at various stages of embryonic development in the silkworm, and it was found that the changes of the percentages of dead eggs at the pigmented egg stages and at the bluish egg stage agreed with those in mutation frequencies. The relationship between mutation induction and the production of cell-killing is discussed. Especially, the relationship of these facts to the hypothesis of selective cell killing is considered to explain the cause of dose rate effect in mutation induction by radiation. (Auth.)

756 Schmidt, C.H., Dame, D.A., Weidhaas, D.E. RADIOSTERILIZATION VS. CHEMOSTERILIZATION IN HOUSE FLIES AND MOSQUITOES. J. econ.Ent. 57, 5 (1964) 753-6.

Laboratory tests were conducted during 1961 and 1962 to compare the effectiveness of males of the house fly, Musca domestica L., and the common malaria mosquito, Anopheles quadrimaculatus Say, sterilized by apholate or tepa and by γ-radiation. For radiosterilization, house fly pupae were treated 31-54 h prior to eclosion with 2850 R and mosquito pupae at least 24 h old with 10 000 or 12 000 R from a ^{60}Co source supplying 736 ± 33 R/min. For chemosterilization, house fly male adults 1 d old were fed 1% apholate in the diet for 3 d and mosquito male adults for 3-4 d after emergence. Mosquito male adults 0-24 h old were also exposed to contact residues containing 7 mg/ft^2 of tepa. The most important criterion of effectiveness was the reduction in number of viable egg batches from females confined with both treated and untreated males. Results from chemosterilization equalled or surpassed those from radiosterilization. With mosquitoes, highly competitive, yet permanently sterile, males were more attainable with chemothan with radiosterilization. With house flies either method seemed adequate, but the slightly greater degree of recovery after irradiation than after chemosterilization must be considered. (Auth.)

757 Snyder, L.A., Oster, I.I. A COMPARISON OF GENETIC CHANGES INDUCED BY A MONOFUNCTIONAL AND A POLYFUNCTIONAL ALKYLATING AGENT IN Drosophila melanogaster. Mutation Res. 1 (1964) 437-45.

A comparison of the spectra of genetical changes induced in mature spermatozoa by a mono- and a polyfunctional alkylating agent and by γ-rays was made using multipurpose stocks having an Y-chromosome genetically marked at both ends. Gamma-rays, typical of ionizing radiations, cause higher frequencies of entire Y- (or X-) chromosome losses than of partial losses of the Y-chromosome. Polyfunctional triethylene melamine, in contrast, was found to induce substantially fewer entire chromosome losses than the sum of losses involving the marker loci on either arm of the Y. Based on a limited sample of partial losses, the relative incidence of sterility among males having lost one or the other of the marker loci after treatment with the polyfunctional chemical was almost twice that found in comparable groups of males following irradiation. Similar data obtained after treatment with monofunctional quinacrine mustard appear to agree with those obtained using the polyfunctional compound, but are too limited to be conclusive. Both the monofunctional and polyfunctional chemicals were found to induce high frequencies of mutations at the dumpy locus, and in both cases very high proportions of these changes were mosaically expressed. On the basis of these results it appears unlikely that the number of reactive groups present in an alkylating compound influences the relative frequency of mosaic changes produced. (Auth.)

See also:

642 Cytogenic investigations on radiation and chemically induced dominant lethal mutations in oocytes and sperm of the screw-worm fly. (LaChance, L.E., Riemann, J.G., 1964)
643 Introduction of dominant lethal mutations in insect oocytes and sperm by gamma rays and an alkylating agent: dose-response and joint action studies. (LaChance, L.E., Crystal, M.M., 1965)
667 Genetic effect of combined x-ray and ethylenimine treatments. (Alexander, M.L., 1965)
669 Combined ICR 100 and x-ray analysis of the strandedness of the spermatozoan of Drosophila melanogaster.
822 Studies on the rate of spermatogenesis in Drosophila: effects of x-rays and streptonigrin. (Martin, A.O., 1965)
922 Age, temperature, coexistence, and x-radiation effects on flour beetles' productivity. (Erdman, H.E., 1964)

B. DEVELOPMENTAL AND PHYSIOLOGICAL EFFECTS ON THE ORGANISM

1. General Articles. Surveys

758(2) Chiang, S.H. STUDY ON THE BIOLOGICAL EFFECTS OF RADIATION OF INSECTS. I. BIOLOGICAL EFFECTS OF EXTERNAL x AND GAMMA RADIATION. J.Agric.For. 12 (1963) 114-41. (In Chinese, with English summary)

759 Menhinick, E.F. STRONTIUM-90-YTTRIUM-90 BETA SOURCE. p.78-9 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct. 1964.

Interest was focused on the effects of β-rather than γ-radiation. Because of low penetration, smaller organisms receive higher tissue doses of β-radiation than larger ones, and insect eggs higher doses than adults. The part played by chitinous shielding, the additive effects of β- and γ-radiation, dose rate effects, and techniques for measuring β-radiation are factors to be considered. Three plane β-sources of 100, 1000, and 10 000 R/h on the surface were constructed to answer some of these questions. The construction of a plane ^{90}Sr source (rather than a point source, to simulate surface contamination) is described. A source 13 in. in diameter gave uniform surface dose rates from the centre up to 1 in. from the edge; 70 mCi of ^{90}Sr-^{90}Y gave 100 R/h (surface rates) through 5 mil of Al, 0.7 Ci gave 1000 R/h, and 7.0 Ci gave 10 000 R/h.

760 Viado, G.B., Manoto, E.C. EFFECTS OF GAMMA RADIATION ON THREE SPECIES OF PHILIPPINE INSECT PESTS. Scient.Rev. 5, 3 (1964) 11-15.

See also:

505 Biological studies. (Japan. National Inst. of Radiological Sciences, Chiba, 1964)

2. Biochemistry. Physiology. Pathogen, Parasite, and Pesticide Susceptibility. Reproductive Potential

761 Ammon, F.-J. ON THE QUESTION OF THE MODE OF ACTION OF A RADON-CONTAINING ATMOSPHERE ON EMBRYONIC STATES OF Drosophila melanogaster. Biophysik 2 (1964) 29-41. (In German)

An investigation was made of the biological action mechanism of radon and its decay products on Drosophila eggs in an atmosphere enriched with radon. It was found that the reduction of the hatching rate of the eggs is due in the first place to α-radiation which is caused by the deposition of radon decay products on the eggs and their support. The dose-effect curves for the lowering of the hatching rate were plotted. (NSA 18:1964, 27100)

762 Bonifay, M., Niaussat, P., Bourcart, R. CONTRIBUTION, A L'ETUDE DE LA RADIO-SENSIBILITE DE CERTAINS ARTHROPODES SAHARIENS. ETUDE DE LA TENEUR DE LEURS PARTIES MOLLES EN ACIDES NUCLEIQUES. RAPPORT EVENTUEL AVEC UNE RADIO-RESISTANCE ELEVEE. C.r. Séanc.Soc.Biol. 158, 3 (1964) 486-90.

The scorpion, Androctonus amoreuxi was exposed to 100 000 R and three species of Tenebrionides (Pimelia angulata lesnei (Peyer.), P. a. expiata (Peyer.), and Ocnera hispida (Forsk)) to 20 000-45 000 R. Determinations of the RNA and DNA contents of their entire soft tissues before and after γ-irradiation showed, within a few days, a large decrease in DNA but very little change in RNA. Some relation appears to exist between the radiosensitivity of a species and the average level of RNA in its tissues.

763 Elbadry, E. THE EFFECT OF GAMMA RADIATION ON HOST-PARASITOID RELATIONSHIPS. Diss.Abstr. 24,12, Pt.1 (1964) 4929.

This investigation was designed to test the possible effect of γ-radiation on host-parasitoid relationships, and illustrated the possibility of using parasitoids as indicators of non-symptomatic pathological conditions induced in a host by sublethal dosages of γ-rays. The experimental animals selected for this work included the potato tuberworm, Gnorimoschema operculella Zeller, as the host insect and three species of its internal parasitoids: the egg-parasitoid, Trichogramma semifumatum (Perkins); the polyembryonic egg-larval parasitoid, Copidosoma koehleri Blanchard; and the larval-parasitoid, Macrocentrus ancylivorus Rohwer. The host insect decreases in radiosensitivity as the immature stages progress in development (see ref.813). The effects on the parasitoid-host relationship are described (see 764), and were marked. Only the egg-parasitoid, T. semifumatum (Perkins), which lacks any intimate physiological relationship with a live host was not materially affected by dosages heavy enough to cause host mortality.

764 Elbadry, E. SOME GAMMA RADIATION EFFECTS ON HOST-PARASITOID RELATIONSHIPS. Ann.ent.Soc.Am. 58,2 (1965) 209-12.

The encyrtid Copidosoma koehleri Blanchard, when reared in previously irradiated potato tuberworm (Gnorimoschema operculella (Zeller)) hosts, showed symptoms of nutritional deficiency which included lessened polyembryony, slower development, and higher mortality in the various stages of the life cycle. The host larvae, irradiated before hatching from the egg, were smaller than normal, weighed less, and stored much less of the suprastomodaeal fat tissue on which C. koehleri subsists during its polygerm stage. The larval period of the braconid Macrocentrus ancylivorus Rohwer was lengthened in such hosts, and there was greatly increased mortality of the adults within their cocoons. However, previous irradiation of the host eggs had no effect on the development of the trichogrammatid egg parasite T. semifumatum (Perkins). Dosages of 0.5-2 krad applied directly to polygerms of C. koehleri in previously unirradiated hosts induced pathological conditions. Embryos grew abnormally large and many failed to complete their embryonic development, and the embryonic period generally was lenghtened. Though irradiation damage was thus evident at a very early stage in C.koehleri, its expression in M. ancylivorus was generally delayed until the adult stage. The percentage of emergence of adults from cocoons was reduced by low dosages given to eggs or larvae, and when such dosages were given to second-stage larvae the females that survived to adulthood were crippled, with short wings and curled ovipositors and antennae. (Auth.)

765 Green, G.W. THE CONTROL OF SPONTANEOUS LOCOMOTOR ACTIVITY IN Phormia regina Meigen. - II. EXPERIMENTS TO DETERMINE THE MECHANISM INVOLVED. J.Insect Physiol. 10,5 (1964) 727-52.

When adults of P. regina are fed to repletion on sucrose solutions, spontaneous locomotor activity is immediately and markedly reduced, increasing again upon subsequent deprivation at a rate dependent upon the concentration of the sucrose solution ingested. Various operative techniques were employed in an attempt to elucidate the mechanisms involved in the control of spontaneous locomotor activity in relation to nutritional state. The rate of crop emptying and its effect on locomotor activity was investigated with x-rays after feeding radiopaque substances ("hypaque sodium") in sucrose solution. The results of the various experiments suggest that spontaneous locomotor activity is controlled by a hormone released from the corpus cardiacum. Release of the corpus cardiacum factor to the haemolymph appears to be under the control of receptors in the foregut capable of monitoring the presence or absence of foodstuffs in that region of the alimentary tract.

766 Henneberry, T.J. EFFECTS OF GAMMA RADIATION ON THE FERTILITY OF THE TWO-SPOTTED SPIDER MITE AND ITS PROGENY. J.econ.Ent. 57, 5 (1964) 672-4.

Females of the two-spotted spider mite, Tetranychus telarius (L.), mated to γ-irradiated males produced fewer female progeny and more non-viable eggs as the dosage of radiation increased. At a dosage of 32 kR there were male progeny and non-viable eggs but no female progeny. Virgin females exposed to γ-radiation and mated to untreated males produced fewer males and females as the dosage increased from 1-24 kR, and after exposure to 32 kR produced only non-viable eggs. Surviving female progeny of males irradiated at 8 kR or more were incapable of reproduction, and female progeny of males irradiated at 2 or 4 kR produced fewer males and females and more non-viable eggs than female progeny of untreated parents. Evidence for sperm inactivation or death was observed at doses of 96 kR and above. (Auth.)

767 Hoopingarner, R.A., Kumararaj, S., French, A.L. GAMETOGENESIS AND RADIATION EFFECTS IN THE CEREAL LEAF BEETLE, Oulema melanopa. Ann.ent.Soc.Am. 58, 6 (1965) 777-81.

Gametogenic development was followed, using histological sections, from emergence of the adult through diapause and oviposition. Some spermatozoa were mature at emergence, and the testes had mainly mature sperm upon entering diapause. Oocyte development did not begin until the subsequent spring after mating took place. Dosages as low as 500 R of x-rays reduced egg production and viability. Complete loss of egg viability occurred when both sexes were irradiated with 5000 R. Loss of egg production occurred with dosages above 5000 R. Spermatozoa were situated within the spermathecae up to and including dosages of 20 000 R to both sexes. (Auth.)

768 Hoover, D.L., Floyd, E.H. A STUDY OF THE CAPABILITY OF THE RICE WEEVILS Sitophilus sasakii AND S. oryzae TO REPRODUCE PARTHENOGENETICALLY. Ann.ent.Soc.Am. 58, 4 (1965) 565-7.

Observations on more than 1000 virgin females of S. oryzae (L.) (sasakii (Tak.)) and 1000 of S. zeamais Motsch. (oryzae, auct.) from emergence as adult insects to natural death of all individuals indicated that parthenogenesis does not occur in either of these species. The results also indicated that the virgin females do not oviposit. Irradiation of virgin females of S. zeamais (doses of 1000 R and 1500 R of x-rays at 100 R/min were administered) with x-rays did not stimulate oviposition. (From auth.)

769 Jones, A.W. A STUDY OF THE EFFECTS OF RADIATION UPON HOST-PARASITE RELATIONSHIPS. p.5 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

770 (2) Kalmykov, P.G. CHANGES OF OXIDATION PROCESSES IN FLIES FOLLOWING γ-IRRADIATION. p.55-56 of "Problemy Parazitologii". Trudy 4-oi Konferentsii Instituta Zoologii, Akad.Nauk Ukr. SSR, Lvov, 1963.

The tissue respiration under conditions of inhibited cytochrome oxidase by HCN was studied in flies after 0.5, 4, 24, and 48 h following γ-irradiation by a dose of 1, 2, 3, and 5 kR. The tissue respiration in the non-irradiated flies under conditions of inhibited cytochrome oxidase was decreased by 70-78%. In the irradiated flies after HCN application a relatively smaller inhibition of the tissue respiration was observed. (CA 61:1964, 15007e)

771 Kalmykov, P.G. CHANGE OF OXIDATION PROCESSES IN INSECTS UNDER THE INFLUENCE OF γ-RAYS. Radiobiologiya 5 (1965) 505-10. (In Russian)

Gamma irradiation (^{60}Co) of winged flies (Protophormia terrae-novae R.D.) and also the eggs, larvae, and pupal stages to 100-300 R decreased the oxygen consumption. The depression continued throughout metamorphosis and subsequent generations regardless of the stage that was irradiated. Breathing was depressed less in irradiated flies poisoned with cyanide than in un-irradiated. The slight depressing action of HCN on breathing in irradiated flies indicates that γ-irradiation has a destructive effect on cytochrome oxidase. (tr-auth.)

772 (2) Karpov, A.E. EXPERIMENTAL ACTIVATION OF LATENT POLYHEDRAL VIRUS AT THE EMBRYONIC STAGES OF THE SILKWORM. Dopov. Akad. Nauk. ukr. RSR 15 (1963) 661-64.

773 Kikkawa, H. Botyu-Kagaku 29 (1964) 37-.

Adult males from a susceptible, isogenic strain (Canton) were subjected to doses of radiation ranging from 2000-3000 R and then mated with non-treated females of the same strain. Some 53 500 F_1 larvae from this cross were reared on media containing 0.5 ppm of parathion, a concentration normally lethal to susceptible individuals. Four larvae survived to adulthood, and by a series of mating to S marker strains they yielded a strain exhibiting intermediate parathion resistance between the parental susceptible and a resistant (Hikone) strain. This resistance was located on chromosome 2 at the same locus (64.5) as that of other parathion R strains (Kikkawa, H., Rep.scient. Wks Osaka Univ. 9: 1961, 1). Cited in Adv. Pest Control Res. 6:1965, 207-8.)

774 Lassota, Z. URIC ACID IN NORMAL AND γ-IRRADIATED EGGS OF Bombyx mori. Acta biochim.pol. 12, 3 (1965) 271-78. (In English)

The uric acid content of B. mori eggs remained constant during diapause and post-diapause embryogenesis. The total N content of the eggs was also constant during this time. Irradiation at diapause with 20 kR of γ-rays, which inhibited the hatching of larvae, did not influence the uric acid content. Uric acid accumulated in dead eggs, whether irradiated or ones which had been stored 10 months at 4°C, only after 10 d of postdiapausal incubation at 25°C. (CA 63:1965, 7317d)

775 Lassota, Z. OXYGEN UPTAKE AND AMMONIA RELEASE IN NORMAL AND γ-IRRADIATED EGGS OF Bombyx mori. Acta biochim.pol. 12, 4 (1965) 369-77.

In normal B. mori eggs, O uptake at 4°C was 37 µl/g/h. Gradual increase in storage temperature to 25°C increased this to 81 in control and to 88 µl/g/h in γ-irradiated eggs (20 or 200 kR). During incubation at 25°C, the respiration rate in the eggs increased to a maximum of 750 µl/g/h a few hours before hatching. In eggs irradiated with 20 kR, respiration increased gradually to a maximum of 300 µl/g/h. In eggs irradiated with 200 kR, there was no increase in the rate of O uptake, although respiration continued at the inital rate for 18 d. Irradiation completely inhibited hatching, eggs irradiated with 20 kR being blocked at the stage corresponding to late gastrula and those irradiated with 200 kR at blastula. Enhancement of respiration due to temperature involved mainly later stages, beginning with blastokinesis. There was no release of NH_3 in irradiated eggs. (CA 64:1966, 5408g)

II/1270 Lavrov, M.T., Bogomaz, V.A. THE EFFECT OF RADIATION ON THE COCKCHAFER, Melolontha vulgaris. Zash. Rast. 6 (1958) 53. (In Russian)*

Cockchafers were irradiated, using ^{60}Co in the form of a solution of its chloride, with an activity of 405 mCi. After 6 d the insects had received 20 851 R. Though the egg-laying capacity of the females had not been greatly impaired no larvae were produced. Such considerable doses of γ-rays were shown to affect the sexual glands in the first place and seem to bring about the complete sterilization of males. The mortality of irradiated M. vulgaris was 2.6-10.8% lower than in controls. The irradiated insects were more mobile and agile, and also consumed more leaves than the controls. Direct irradiation of the cockchafer is concluded to be inappropriate as a method for rapid extermination but can be put to advantage in sterilizing pupae and adults.

776 Maynard, E.A. INVESTIGATION OF THE EFFECTS OF RADIATION ON THE HAEMOCYTES OF Tenebrio molitor L. p.43-44 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

777 Menhinick, E.F. METABOLISM OF CRICKETS. p.76-8 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct.1964.

To determine the extent to which radiation may affect energy requirements and thereby cause changes in community structure, a study was made of the feasibility of simultaneous measurements of different aspects of energy flow: ingestion, defecation, O_2-consumption, and production. Over a period of 42 d the crickets consumed an average of 435 mg meal/individual and 4 mg of dead crickets; 160 mg was lost in faeces, standing crop increased 38 mg, skins weighed 2 mg, and mortality accounted for 8 mg; this gave a total production of 48 mg. O_2-consumption for this period was 166 ml at STP. The effects of radiation on energy flow, and the relation of isotope uptake, loss, and equilibrium with energy flow are being studied.

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* No abstract was available in Vol.II/1270.

778 Neidinger, J.W., Baratz, R.A., Moos, W.S. OXYGEN UPTAKE OF THREE LIFE STAGES OF Tenebrio molitor PRIOR AND SUBSEQUENT TO MASSIVE DOSES OF LOW ENERGY x-RAYS. Atompraxis 11, 9-10 (1965) 564-8.

The pre- and post-irradiation oxygen uptake of T. molitor, larvae, pupae and adults was measured at 45 kV x-rays at doses of 4.6×10^4 to 1.4×10^5 R and a dose rate of 760 R/s were employed to irradiate the beetles. Comparison of experimental animals and controls shows trend to reduced O_2-consumption at lower doses and enhanced O_2-consumption at the higher. (Auth.)

779(2) Niaussat, P., Pascaud, A., Grenot, C., Pierre, F. CONTINGENT RELATION BETWEEN THE RESISTANCE TO γ-RADIATION OF CERTAIN ARTHROPODS OF THE SAHARA AND THE NUCLEIC ACID CONTENT OF THEIR TISSUES. Bull.Soc.Méd.milit.Franc. 57 (1963) 295-9. (In French)

Several scorpions and coleoptera indigenous to the Sahara were irradiated with γ-rays. The LD50/30 (continuous whole-body irradiation) was found to be ~100 000 R for Androctonus amoreuxi and ~30 000 R for Pimelia angulata, compared with 60 000 R for Drosophila melanogaster and 20 000 R for Tribolium confusm. The relation between this high resistance and the content of tissue in DNA and RNA was examined. The scorpions (7 animals) were found to contain a mean of 11.35 ± 1.33 mg RNA phosphate and 1.02 ± 0.20 mg DNA phosphate per 100 g soft parts. For two specimens of Pimelia (imago) these values were 14.6, 15.6 and 2.41, 4.58, respectively. For comparison, the values for Drosophila larvae are reported to be 42, 53 and 2.92, 3.12; the salivary glands of Drosophila have values 33.8, 42.6 and 3.9, 4.2, respectively. These results do not permit conclusions but allow the question to be proposed: is there a relation between radiation resistance and the tissue content in DNA of an organism? These species studied all have low DNA values, and the morphology of scorpions has scarcely evolved since the Silurian period. The content of DNA in the venom is found to be practically zero. (NSA 18:1964, 36965)

780 Norsk Hydro's Inst. for Cancer Research, Oslo. FIFTH REPORT FROM NORSK HYDRO'S INSTITUTE FOR CANCER RESEARCH FOR 1963-1964. NP-15585. 1965, 68p.

Among many other studies some work on the effects of injected ^{91}Y on reproduction in Drosophila is reported, and on the radiosensitivity of Drosophila spermatogonia to x-rays.

781 Piechowska, M.J. EFFECT OF IONIZING RADIATION ON THE ENDOCRINE SYSTEM IN INSECTS. Bull.Acad.pol.Sci.Cl. II Sér.Sci.biol. 13 (1965) 139-44.

Celerio euphorbia at different stages of homodynamic development was used to study the effect of ionizing radiation on the functions of the endocrine system in this insect. Caterpillars and pupae were irradiated with γ-rays from ^{60}Co at a dose of 2600 R. All groups studied were affected by this dose but the resulting changes differed widely. The youngest caterpillars were the least resistant; in 95%, growth and increase of weight stopped and death occurred between the 15th and 25th day after irradiation. In older caterpillars the damage by irradiation was less severe. In the surviving caterpillars deficiency in weight was observed, the difference being greater for animals irradiated during instar III than during instar IV. In the groups irradiated at later stages of development the mortality did not differ from that in the control group; after eclosion, however, external malformations of the adult moths appeared. The injuries were the greatest in animals irradiated at the end of the V instar; 40% of the eclosed moths exhibited deformations of head, both pairs of wings and of legs. They could fly only with difficulty, if at all; some could not even walk. In males, only spermatocyte cells in earlier development stages were present. In females, both ovaries and ova were underdeveloped, and only a few ripe eggs, if any, were found. Immaturity of ova was evaluated from the composition and number of protein fractions obtained in paper electrophoresis. In normal ripe ova only four fractions were found, their distribution being similar to that of corresponding haemolymph fractions. In ova from females irradiated during the instar III and IV five fractions were found, their proportions being dependent on the extent of injury caused by irradiation. In the females with no ripe eggs, the amount of fraction I was small and that of fraction IV twice that in the control. When more ova were ripe, the proportion of fraction I was markedly higher. Generally, the less the ovaries were affected and more ripe eggs were present, the greater was the similarity in distribution of the protein fractions with the control, and vice versa. The underdevelopment of the reproductive organs and ova observed in these experiments in C. euphorbiae may be related to a radiation-induced disturbance in the hormonal system. This suggestion is corroborated by the observation that γ-rays also have an inhibitory effect on the excretion of the juvenile hormone during the moulting of caterpillars. (NSA 19:1965, 45861)

782 Po-Chedley, D.S. EFFECT OF x-RAYS ON THE MEAL WORM, Tenebrio molitor, EMBRYO. I. CHANGES IN THE PROTEIN AND FREE A-AMINO NITROGEN FRACTION. Terminal Summary, October 15, 1964. NYO-2814-1, D'Youville Coll., Buffalo. 1964, 7p.

Data are presented on daily survival curves and the protein electrophoretic patterns observable for normal and x-irradiated embryos. 20 free ninhydrin-positive substances were tabulated which had been detected in T. molitor. Variations in concentration reach a max., generally on the 4th day of growth. Slight changes occur during the remaining interval leading to larval eclosion. Results of x-irradiation on the amino acid pool of 4-d-old embryos are tabulated. The changes (decreases) induced in concentration were not permanent; a gradual readjustment was observed during the 72 h which followed. Hatching was delayed by ~3 d. Changes in concentration were shown graphically. Radiation resistance increases with developmental progress.

783 Po-Chedley, D.S. THE EFFECTS OF x-RAYS ON THE MEAL WORM, Tenebrio molitor, EMBRYO. p.180 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul.1964". Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

Findings are reported on proteins and free amino acids found in the developing meal worm embryo, the variations observed following x-ray stimulation, and the preparation of survival curves for the x-irradiated embryo. Data for the meal worm embryo shows that its resistance to x-irradiation increases with each day of embryological growth. The dosages required to yield a 50/8 MLD effect ranged from 150 R for the one-day-old embryo to 41 000 R for the 8-d-old embryo. The survival curves obtained for this period of development indicate that resistance to irradiation builds up rapidly to the 4th day of growth. After that interval the resistance increases at a slower rate. The a-amino N content, free amino acids and derivatives, detected in the developing embryo also showed a progressive increase in concentration during this period of growth. A total of 20 free ninhydrin positive compounds have been identified on one and two-dimensional paper chromatograms for the normal embryo. There was a general increase in concentration for these compounds during the course of embryological development. Paper electrophoretic patterns of the proteins found in normally developing embryos are represented by two distinct anodal fractions separated by an area of low concentration. The effects of x-irradiation on the embryo are characterized by a third and fast moving anodal fraction. When this occurred in the older embryos, 4-6 d old, the induced fraction gradually subsided and disappeared in about 72 h. These embryos successfully completed their embryological growth. During this same period there was a disturbance in the amino acid "pool" in that asparagine, arginine, histidine, phenylalanine, serine, threonine, tryptophane, tyrosine and valine increased in concentration while a-alanine, aspartic acid, cystine, glutamic acid, glutamine, glycine, methionine and proline decreased in concentration in comparison with normal values. These variations were gradually readjusted to normal conditions by the surviving embryos during the post-irradiation period. As amino acids provide some protective action, a part of the radiation resistance of insects may be explained by means of this physiological factor. (From abstr.)

784(2) Puro, J.A. TEMPORAL PATTERN OF THE EARLY STAGES OF SPERMATOGENESIS OF ADULT Drosophila melanogaster MALES AFTER TREATMENT WITH x-RAYS. TID-21466, Turku Univ. (Finland). Dep.of Genetics. 1961, 16p. Paper presented at "2nd International Congress on Radiation Research, Harrogate, Yorkshire, 5-11 Aug.1962".

For further details see: II/896.

785 Rockstein, M., Bhatnagar, P.L., Dauer, M. THE EFFECTS OF HIGH LEVEL x-IRRADIATION ON ADULT HOUSE FLY FLIGHT ABILITY AND LONGEVITY. Bull.ent.Soc.Am. 11, 3 (1965) 158. Abstr.78. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.- 2 Dec.1965".

Whereas x-irradiation dosages of up to 8000 rad to the pupae produces reduction in life span of adult males and females, higher doses result in increased male longevity and a marked retardation in otherwise normal wing loss, with a maximum (optimal) effect at 30 000 rad. (Abstr.)

786(1) Semin, V.S. Sci.Comm.Moldavian Coun.Minist. 5(1959) 46.

Females of the vine pest, Phylloxera, treated with 10 000 R of radiation are reported to begin to lay eggs parthenogenetically earlier than controls. (From "Insect Control", ref.1062)

787 Touchberry, R.W., DeFries, J.C. GENETIC EFFECTS OF GAMMA-IRRADIATION ON EGG PRODUCTION AND ADULT EMERGENCE OF Drosophila melanogaster. Genetics 49, 3 (1964) 287-400.

Newly emerged male and female flies from one inbred and one randombred population were subjected to 0, 500, 1000, or 1500 R of γ-radiation and then mated in all possible combinations within populations, resulting in a four × four factorial arrangement of treatments. Daily egg production over a 10-d period was determined from two replicated experiments for the treated flies, their untreated progeny (Generation 1) and grand-progeny (Generation 2). Generation 2 resulted from full-sib matings of members of Generation 1. Eggs laid each day which resulted in viable adults were determined for Generations 1, 2, and 3 (Generation 3 resulting from two generations of full-sib mating). Mean daily egg production was not significantly affected by irradiating males or females with 1500 R or less of γ-rays; however, irradiation of the female parent with 2000 R or more of x-rays had a marked depressing effect on egg production. Irradiation of the male parent did not affect egg production appreciably. The partial linear and quadratic regression coefficients of daily egg production on day of oviposition for each pair of flies indicated no significant differences associated with levels of irradiation of males or females. Large linear depressing effects associated with irradiation of both male and female parents were found in Generation 1 for mean daily percent adult emergence. Treatment of the males had a significant effect on descendants. The weighted partial linear and quadratic regression coefficients of percent adult emergence on day of oviposition were determined for each pair of flies. Analyses of the differences of these coefficients indicated that secondary spermatocytes and early spermatids were more sensitive to radiation induced genetic damage than were spermatozoa, later spermatids, primary spermatocytes, and spermatogonia. Less differential effect was found for irradiation of females than males. Nevertheless, gametes treated as primary oocytes were more susceptible to damage than those treated as oogonia. Irradiation of male Drosophila resulted in four to five times as much genetic damage in the gametes as did irradiation of the female. Evidence of this greater damage is also present in the gametes produced by the progeny and grand-progeny of irradiated males, the extent of the damage being approximately halved each generation. (From auth.)

788 Wharton, D.R.A., Wharton, M.L., Lola, J.E. WEIGHT AND BLOOD VOLUME CHANGES INDUCED BY IRRADIATION OF THE AMERICAN COCKROACH. Radiat. Res. 25(1965) 514-25.

Exposure of the cockroach to 10 000 rad of β-radiation from a 2-MeV Van de Graaff electron accelerator caused an early and continuous loss of body weight, except on the 3rd day after irradiation. The body weight of the whole irradiated insect on the 3rd day after irradiation was greater than that of the fed or the starved controls because of an excessive intake of water, much of which is retained in the crop. Body weight became more irregular with dehydration and an increasing mortality rate. Percent weight losses in the intestine, fat body, and gonads were greater than in the body at large. The fat body lost less weight in the irradiated insects than in the controls, possibly because of the lower metabolic rate or of retained metabolic water. The blood volume percent (μl/100 mg of body weight) was much reduced post-irradiation, and an increasing number of insects failed to bleed as the mortality rate rises. The percent total body water of the whole irradiated insect was greater than in the fed and similar to that of the starved controls. The similarity was due to the generally large intake of water by the irradiated insects. When the intestines were removed, the body water was found to be less and differently distributed in the irradiated insect. The probable causes of water changes are discussed. (Auth.)

789 Yanders, A.F. THE EFFECTS OF x-RAYS ON INSEMINATION AND SPERM RETENTION IN Drosophila. Genetics 49, 2 (1964) 309-17.

The effect of x-rays on insemination success and retention of sperm during storage in inseminated females was studied by direct microscopic estimates of the relative fullness of excised ventral receptacles in female D. melanogaster dissected at intervals following mating. Males were treated at 12 x-ray dose levels ranging from 500-75 000 R and mated for 24 h to untreated, virgin females. The insemination success in groups of females dissected immediately after the mating period was significantly lower in treated groups than in the controls at all doses of 4000 R or more. The reduction in insemination was proportional to -0.0066 times the dose in kiloroentgens at doses to 40 kR, and was even more extreme at doses of 60 kR and 75 kR. Males were treated with 4000, 25 000, or 50 000 R of x-rays and mated for 24 h to virgin untreated females. The insemination success in females dissected immediately after the mating period was lower in each treated group, and the retention of sperm after 7 and 14 d of storage in the females was drastically reduced in the 25 000 and 50 000 R groups. Inseminated females were treated at eight x-ray dose levels ranging from 5000 R to 50 000 R and dissected at times ranging from 2 h-17 d after irradiation. Reductions in the success of sperm retention were first noted 24 h after irradiation at the highest dose levels, and became evident even at lower doses within the 17-d storage period. It is concluded that some aspect of sperm behaviour, possibly motility, is affected by x-rays at doses within the range commonly employed in genetic studies. This finding is significant for the analysis of induced mutation rates in Drosophila. (Auth.)

See also:

19 Some physiochemical indexes of gaseous exchange in the housefly Musca domestica and of DNA nucleotide composition of first-generation larvae, following internal γ-irradiation by phosphorus-32. (Kharmalov, V.P., 1964)

657 The effect of γ-irradiation on fecundity and fertility of Tribolium confusum Duval. (Vereecke, A.. Pelerents, C., 1965)

666 The effects of radiations on the genetic systems of organisms in relation to their physiological and biochemical systems. (Alexander, M.L., 1964)

671 Morphological and reproductive variation under four environmental pressures in an inbred strain of Drosophila melanogaster. (Come, T.V., 1964)

675 x-ray and fast neutron effects on productivity of flour beetles. (Erdman, H.E., 1965)

739 The sensitivity of the male germ cells of Drosophila to methyl methanesulphonate. (Bateman, A.J., Chandley, A.C., 1964)

752 Studies of the effect of meat exposed to gamma radiation or chemosterilants on the reproductive capacity of a blow fly Phaenicia cuprina (Wiedemann). (Morgan, P.B., Labrecque, G.C., 1964)

813 Some effects of gamma radiation on the potato tuberworm, Gnorimoschema operculella (Lepidoptera: Gelechiidae). (Elbadry, E., 1965)

814 Differential responses of germ cells in flour beetles, Tribolium castaneum Herbst, due to x-ray dose, hypothermia, sex exposed and age. (Erdman, H.E., 1964)

817 The effect of gamma irradiation on the varo race of Bombyx mori. II. Irradiation of eggs in the early and late embryonic stages. (Gubicza, A., Molnar, I., 1964)

819 Possibilities of controlling Callosobruchus subinnotatus Pic (Bruchidae) by gamma rays. (Huque, H., Khan, M.A., 1964)

820 Effects of ionizing radiation on eggs and adult insects. (Lippold, P.C., Gambrell, F.L., 1965)

823 Biological and histopathological effects of gamma radiation on three life stages of Anthonomus grandis Boheman. (Mayer, M.S., 1964)

825 Effects of gamma radiation on the postembryonic stages of a dermestid beetle, Anthrenus vorax Waterhouse. (Nair, K.S.S., George, J.C., 1965)

839 The effect of x rays on adult Hyalomma asiaticum. Communication I. (Sidorov, V.E., Grokhovskaya, I.M. 1964)

854 The effects of gamma radiation on the fertility and longevity of Hippelates pusio. (Flint, H.M., 1965)

861 Effects of gamma rays on mortality, longevity and fecundity of some species of fruit flies. (Narayana, E.S., et al., 1963)

869 Susceptibility of the confused flour beetle, Tribolium confusum Duv., and the rust-red flour beetle, Tribolium castaneum (Herbst), to gamma radiation. (Banham, E.J., Crook, L.J., 1966)

888 Modifications of productivity in flour beetles, Tribolium castaneum Herbst, due to x-ray dose, hypothermia and the sex exposed. (Erdman, H.E., 1965)

890 Synergistic action of radiation and of Bacillus thuringiensis toxin on protozoan diseases of insects. (Jafri, R.H., 1963)

891 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1964)

892 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1965)

893 Prospects of integrated radiation and microbial control of harmful insects. (Jafri, R.H., 1965)

895 Factors influencing biomagnetic environments during the solar cycle. (Levengood, W.C., 1965)

910 Some observations on the mating activity and fertility of Drosophila melanogaster males. (Kvelland, I., 1965)

913 The effects of x-radiation on plateaued populations of Tribolium castaneum in regard to reproductive fitness and response to selection. (Bell, A.E., 1964)

914 The effects of x-radiation on plateaued populations of Tribolium castaneum in regard to reproductive fitness and response to selection. (Bell, A.E., 1964)

919 Fast-neutron effects on productivity of young and old flour beetles, Tribolium castaneum Herbst, and alterations at different temperatures and after exposure of either or both sexes. (Erdman, H.E., 1965)

920 Fast neutron effects on flour beetles. (Erdman, H.E., 1964)

921 Fast neutron effects on productivity of young and old flour beetles, Tribolium castaneum Herbst and alterations due to temperature and sex exposed. (Erdman, H.E., 1964)

922 Age, temperature, coexistence, and x-radiation effects on flour beetles' productivity. (Erdman, H.E., 1964)

923 Reproductive performance of x-rayed single-species and mixed-species cultures of Tribolium confusum and T. castaneum reared at different temperatures. (Erdman, H.E., 1964)

924 A study of radiation on the biology and population dynamics of the cereal leaf beetle, Oulema melanopa (L.), order Coleoptera, Family Chrysomelidae. (Myser, W.C., 1965)

1001 Control of weevil populations (Sitophilus granarius (L.)) with sterilising and substerilising doses of gamma radiation. (Cornwell, P.B. et al, 1966)

1014 Effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (L.). (Jefferies, D.J., 1966)

3. Tissue. Organ

790 Baldwin, W.F., Sutherland, J.B. EXTREME SENSITIVITY TO LOW-LEVEL x-RAYS IN THE EYE OF THE COCKROACH Blaberus. Radiat. Res. 24 (1965) 513-8.

Electroretinograms were induced in the compound eyes of B. giganteus by x-rays. The response increased with dark adaptation, an effect that appears to be associated with the migration of eye pigments. The magnitude of the response depended on the total dose of x-rays over the range from 0.09 to 22.4 MR and was independent of dose rate from 1.2 to 41 R min. The reaction in the ommatidia appeared to be stimulated by single photons. Thus, a refinement of techniques for the measurement of ERG's from single ommatidia may permit the detection of a response at even smaller doses. (Auth.)

791 Baroughi-Bonab, H. STUDY OF THE POST-EMBRYONIC DEVELOPMENT OF THE OVARY IN Ephestia kühniella Z. (LEPIDOPTERA, PYRALIDAE). I. EFFECT OF IONIZING RADIATIONS. Fd Irrad. 6 (1965) A13-A14.

Female caterpillars were irradiated with doses ranging from 2000-15 000 rad. Nymphosis, which took place within 7 d in the controls, was delayed from 9 d in the 2000 rad group to 31 d in the 14 000 rad group. Duration of nymphosis was only slightly affected by irradiation. Radiation effects on ovaries and oogenesis at the various dosages are discussed. Chrysalids were affected less than final-stage caterpillars. (NSA 20: 1966, 18329)

792 Carney, G.C. THE EFFECTS OF IONIZING RADIATION ON THE SARCOSOMES OF HOUSEFLY FLIGHT MUSCLE. Diss. Abstr. 25, 9 (1965) 4917.

An investigation concerning the examination of sarcosomes which had been exposed to in vivo and in vitro doses of x-rays in the range of 50 000 to 200 000 R at 5000 R/min is described. Sarcosomes were extracted from the flies within 1 h of irradiation and were studied with respect to their morphology, respiration, uptake of inorganic phosphate, and cytochrome c content. Since the wing-beta frequency of flies appears to be dependent, at least partially, on the cytochrome c content of the muscle tissue, one experiment was carried out to measure the frequency before and after the flies were exposed to a dose of 50 000 R. The results indicated a considerable alteration in the physiological properties of the sarcosomes as a result of irradiation in vivo. Irradiated sarcosomes swelled much more than control preparations when suspended in 0.1N KCl solution. Also, a more rapid leakage of cytochrome c was detected in isolated sarcosomes from irradiated flies. On the basis of a limited number of experiments there was evidence that the uptake of inorganic phosphate and the synthesis of ATP (as indicated by the P/O ratio) was impaired in sarcosomes which had been irradiated in vivo at doses above 50 000 R. There was no evidence, however, to indicate that house fly cytochrome c was appreciably altered by in vivo irradiation at doses below 100 000 R. Wing-beat frequency was depressed by about 40% in an experiment in which flies were tested before and immediately after irradiation. No changes in the cytochrome c content of sarcosomes were detected as a result of in vitro irradiation. In conclusion, it may be stated that the radiation effects detected appear to stem from changes in the properties of the sarcosomes. (From DA)

793 Carney, G.C. SWELLING AND SHRINKAGE PROPERTIES OF HOUSEFLY SARCOSOMES AFTER IN VIVO EXPOSURE TO x-RAYS. Radiat. Res. 25 (1965) 637-45.

The swelling behaviour of Musca domestica sarcosomes, situated between the fibrils of the flight muscles, suspended in unbuffered 0.1 M KCl solution was studied after in vivo exposure to x-rays in the dose range 25 to 100 kR. The irradiated sarcosomes swelled more rapidly than the controls and at a rate proportional to dose. Reversal of swelling was obtained by the addition of ATP in the form of its acidic disodium salt. Neutralized ATP had no effect on the swelling rate. The contraction of sarcosomes in response to ATP was less pronounced after in vivo irradiation. The difference between treated and control sarcosomes with respect to their swelling behaviour and their response to ATP is discussed in relation to their energy-supplying function and the depression in wing-beat frequency which results from irradiation. (Essentially auth. summary)

794 Elbadry, E. THE EFFECT OF GAMMA IRRADIATION ON THE HEMOCYTE COUNTS OF LARVAE OF THE POTATO TUBERWORM, Gnorimoschema operculella (ZELLER). J. Insect Path. 6 (1964) 327-30.

The effect of ^{60}Co γ-irradiation on total haemocyte counts (THC) and differential haemocyte counts of larvae in 3 instars of the potato tuberworm was evaluated. Irradiation with 3000 and 9000 rad had a noticeable effect on the total haemocyte counts. The THC decreased in treated larvae, regardless of whether they were subjected to irradiation at an early stage of development or at an advanced stage. By comparing the 3-larval-instars that had been subjected to 3000 or 9000 rad, it was clear that the 3rd instar was less affected as to the reduction of THC, which indicates that the 3rd-instar larva is more resistant than earlier instars to the effect of irradiation on blood cells. However, statistical analysis revealed no significant difference between THC of larvae of the same age treated with 3000 and 9000 rad. The THC of insects vary greatly with technique, species, stage of development, various physiological states within a stage, and many other factors. For example, in some cases, the THC increase briefly with bacterial infections but in others may show no change or may even decrease. The THC may be greatly affected by the nutritional state, and this might be an explanation for the decrease of THC or irradiated tuberworm larvae. Irradiated larvae were of smaller size and lighter weight than non-irradiated controls. Also studied was the effect of γ-rays in the differential haemocyte count. Three cell types were recognized, namely, plasmatocytes, adipohaemocytes, and spheroid cells. In untreated insects, the plasmatocytes were found to constitute about one-third of the total blood cells. No conclusions could be drawn from the results obtained, except that the blood picture is not significantly changed by irradiation. Some morphological changes in the plasmatocytes were observed. Small numbers of plasmatocytes had an elongated shape with slightly larger nuclei. (NSA 19:1965, 33860)

795 Girardie, A. ACTION DE LA PARS INTERCEREBRALIS SUR LE DEVELOPPEMENT DE Locusta migratoria L. J. Insect Physiol. 10, 4 (1964) 599-609. (With English summary)

The destruction of the pars intercerebralis in the last two larval stages (IV and V) of the gregarious phase of L. migratoria by x-rays or cauterization alters the normal development of this insect. Moulting is stopped or delayed as after the removal of the ventral glands. Animals which moult have their metamorphosis, pigmentation, and development of the oocytes similar to animals which have been implanted with active corpora allata: the fifth moult results in metathetelic animals, or imperfect adults, or normal adults, and most animals are green. The other animals remain dark or become pale. The destruction of the pars intercerebralis can also completely prevent the growth of the terminal oocytes in the ovaries. The operated locusts contain in the sixth stage extremely large volumes of blood which greatly distend the abdomen. From all this it can be concluded that the pars intercerebralis in L. migratoria exerts control over the activity of the central glands and the corpora allata. The pars intercerebralis without the intermediacy of the corpora allata acts also on the chromatic adaptation, on oocyte development, and on metabolism. (Auth.)

796 Larsen, W. CELL PROLIFERATION IN AN INSECT TISSUE CULTURE. Life Sci. 3, 2 (1964) 103-6.

Fragments of heart, pieces of head, Malpighian tubules, and digestive tract were isolated from 66-d-old embryos of the cockroach, Blaberus craniifer, and placed in Ringer solution. The isolated portions were transferred to culture dishes containing medium T.C. 199 to which both lactalbumin hydrolysate and yeast autolysate had been added. Renewal of the culture medium was made only when pH changes indicated that fresh medium was necessary. No insect blood was used. Six of 30 heart fragments proliferated round hollow balls of tissue; new growth was not initiated until the fragments had been in the culture fluid for almost 5 months. In one case a heart fragment did grow new tissue in 199 alone without added hydrolysate, but the new growth did not take place until one year after the fragment had been exposed to 10 000 R of x-irradiation.

797 Larsen, W. SURVIVAL OF ISOLATED EMBRYONIC HEART FRAGMENTS FOLLOWING TREATMENT WITH SOME RADIATION PROTECTING CHEMICALS. Life Sci. 3 (1964) 539-43.

Heart fragments from 82-d-old embryos of the cockroach, Blaberus craniifer, were placed in screw-cap glass vials each containing 5 ml of culture fluid to which penicillin, streptomycin, and mycostatin had been added. There were four hearts in each vial. The fragments were exposed to γ-irradiation from a ^{60}Co source at a rate of 92 620 rad/h. Heart beat was selected as the function to determine survival of the tissues. Of 56 heart fragments exposed to 82 000 rad over half stopped beating for a 24 h period following irradiation. This interval of inactivity was designated as the initial shock period. A period of recovery followed during which 90% of the heart fragments started to function again. Some hearts of the irradiated control group continued to beat for 10 d. It was found that by adding bis (2-amino-4-sulphonamide-phenyl) disulphide (ASPD) the shock period did not appear and the survival time was extended. Using AET, the survival curve followed the general pattern of an untreated control group. There was an initial shock period and a period of recovery. Survival time was slightly longer. The efficacy of AET was seen better at 44 000 R where heart fragments functioned for 59 d. Using isoleucine the survival time was no longer than that of the controls (10 d). (NSA 19:1965, 13103)

798 Larsen, W. THE EFFECTS OF x IRRADIATION ON THE EMBRYOS OF INVERTEBRATE EMBRYOS. TID-21877, College of Southern Utah, Cedar City, 1965, 13p.

The effects of x-radiation at dosages ranging from 50-12 000 R on the development of embryos of the ovoviviparous cockroach, Blaberus craniifer, exposed at various ages ranging from 1-52 d were studied. Approximately 3750 embryos were examined and microscopic sections made of the specimens exhibiting gross deformities, cessation of growth, or abnormalities in size. Embryos were found to become resistant to x-radiation suddenly just prior to the stage of dorsal closure. Embryos that had passed this stage when irradiated continued to develop normally until dosages reached levels of 2000 to 5000 R. Gross abnormalities ranged from individual slightly retarded in growth to embryos represented by an amorphous mass. Typical abnormalities found are described. Tissue cultures of heart fragments, gut sections, and Malpighian tubules of Blaberus were prepared and survived for periods varying from 5 months-2.5 yr. The effects of γ-radiation at dosages up to 93 000 rad were studied, the use of heart function in heart fragments in testing various radioprotective chemicals, and the effects of oxygen and hypothermia on radiosensitivity were investigated. Results are summarized. Data are also included from studies of reactions of heart fragments from embryos of Blaberus to several vital stains and the effects of various growth hormones on the growth pattern of embryonic insect organ cultures. (NSA 19:1965,29903)

799 Monro, J., Bailey, P.T. INFLUENCE OF RADIATION ON OVARIAN MATURATION AND HISTOLYSIS OF PUPAL FAT BODY IN DIPTERA. Nature, Lond. 207 (1965) 437-8.

The effects of x-radiation on ovarian development and histolysis of the pupal fat-body was studied in Dacus tryoni that were treated in the pupal stage with 8000 R of γ-radiation given to: the whole body, the anterior third of the body, or the posterior third of the body. Results were interpreted to mean that radiation blocked an abdominal stimulus, thus indirectly preventing ovarian development. Radiation did not act hormonally and the contention was supported that it directly damaged the ovarian nurse cells, which in turn probably reduced demand on the pupal fat-body and delayed its histolysis. (NSA 19:1965,38406)

800 Nachtigall, W. UNTERSUCHUNGEN AM ELEKTRORETINOGRAMM ÜBER DIE WIRKUNG IONISIERENDER STRAHLEN AUF DAS KOMPLEXAUGE VON INSEKTEN. (Electroretinogram studies on the effects of ionizing radiation on the compound eye of insects). Biophysik 2, 3 (1965) 145-65. (In German)

Heavy doses of x-rays have a damaging effect on the insect eye, low doses a stimulating effect. Electroretinograms (ERG) formed by periodic light flashes were damaged by medium doses of x-rays. As a result a third ERG component could be distinguished in insects which show various types of ERG. The insect eye reacts to x-rays flashes with an ERG. This has a more or less similar form to the light ERG, except for a longer latent period. The threshold dose is < 10 mR. Possible mechanisms of action are discussed. Most of the work was carried out on Calliphora erythrocephala (Meig.). Altogether 100 individuals were used belonging to 17 species (Diptera, Lepidoptera). Results are based on 62 experiments and 3500 ERG photos.

801 Riemann, J.G. CYTOLOGICAL EFFECTS OF RADIATION ON TESTES OF THE SCREW-WORM FLY, Cochliomyia hominivorax. Genetics 50, 2 (1964) 279. Abstr.

A study was made of the cytological effects on screw-worm testes of from 51-6200 R of γ-radiation. Most of the youngest primary spermatocytes were killed after having received only 100 R, the older secondary spermatogonia after 500 R, and in different tests all primary spermatogonia were destroyed at levels from 1500-3000 R. Some cells of all three classes were killed even at the 51 R level. Few, if any more, spermatocytes were killed with higher radiation doses than with 100 R, and in all cases the surviving cells apparently went through the meiotic divisions. However, increased chromosomal damage was evident with increased dosage, and at the highest radiation level most of the spermatids formed from irradiated spermatocytes failed to develop into mature sperm although they failed to degenerate. On the other hand, those cells that were irradiated as spermatids did develop into normal appearing sperm. – The stage and time at which death occurred in different cell types was also investigated. It was found that all susceptible cells died prior to division and that decay became evident later in the more resistant types than in those less so. – In testes where some primary spermatogonia survived a dose of 1500 R the first divisions of their spermatocyte descendants were found on the 7th or 8th after irradiation. (Abstr.)

802 Seidel, F. ANALYSE DES DIFFERENZIERUNGSVERLAUFS IM INSEKTENEI (Gryllus) MITTELS UV- UND RÖNTGENBESTRAHLUNG. (Analysis, by means of x- and u.v.-irradiation, of the course of differentiation in the insect egg (Gryllus)). Zool. Anz., Suppl., 27 (1964) 121-43. (In German)

Work done by the author and his group is reviewed. Gryllus domesticus eggs were used in the studies. The process of differentiation is initiated by a differentiation centre where the cells first aggregate and begin to show segments and organ formation, etc. Thirty hours after oviposition it was possible to recognize 20-40 contraction foci; subsequently, streaming was noted on the egg surface and, later, a combination of the two. Vitellophages become active close to the egg surface shortly before yolk contractions and initiate dissolving of yolk material at the cell surface. Finally, already 25 h after oviposition, the reproductive activity of the cells starts to become very noticeable. General irradiation with x-rays can alter cell reaction, cell viscosity, and therefore sensitivity to conditions within the yolk-entoplasm system. x-irradiation may cause inverse development of the embryo or alter blastoderm aggregation, depending on the stage irradiated. Regulatory activity and differentiation are discussed. The radiosensitivity of different cells (type, location, age) to irradiation and the extent to which irradiation affects their regulatory activity are described and discussed. Depending on the age of the "Keimanlage" cells at the time of irradiation, the defects will be noticed in different but definitely localized parts of the animal's anatomy. The complexity of the whole process of differentiation as studied with x-rays (and u.v.) is discussed.

803 Smith, J.C., Kimeldorf, D.J. THE BIOELECTRICAL RESPONSE OF THE INSECT EYE TO BETA-RADIATION. J. Insect Physiol. 10, 5 (1964) 839-47.

Beta-radiation can induce a bioelectric reaction in the compound eye of the insect. The electroretinogram is indistinguishable from that produced in response to a light stimulus. A difference exists between light and β-radiation in the time course of the dark-adaptation process. It was demonstrated that the disparity depends upon the interaction of distal pigment with the light stimulus. An electroretinogram was elicited by a β-radiation exposure dose of 0.25 mR at a radiation dose rate of 20 mR/sec. Moths, Agrotis ypsilon (Rottemburg) and Pseudaletia unipuncta (Haworth), of the family Noctuidae were used.

804 Sun, S., Lee, W. HISTOPATHOLOGICAL STUDIES ON THE EFFECTS OF GAMMA IRRADIATION ON THE OVARIAN TISSUES OF Ostrinia nubilalis (Hübner). Acta ent. sin. 14, 5 (1965) 432-31. (In Chinese, with English summary)

See also:

519 Behaviour of the puff pattern of the salivary-gland chromosomes in Chironomus under the influence of Drosophila egg contents. (Lezzi, M., 1961)
533 Biological effects of radiation. (Grosch, D.S., 1965)
598 Mutation rates at specific autosomal loci in different species of Drosophila. (Hannah-Alava, A., 1964)
606 Radiation induced viability mutations in the honey bee. (Lee, W.R., 1964)
762 Contribution à l'étude de la radiosensibilité de certains arthropodes sahariens. Etude de la teneur de leurs parties molles en acides nucléiques. Rapport eventuel avec une radiorésistance elevée. (Bonifay, M. et al., 1964)
767 Gametogenesis and radiation effects in the cereal leaf beetle, Oulema melanopa. (Hoopingarner, R.A. et al., 1965)
776 Investigation of the effects of radiation on the haemocytes of Tenebrio molitor L. (Maynard, E.A., 1964)
779 Contingent relation between the resistance to γ-radiation of certain arthropods of the Sahara and the nucleic acid content of their tissues. (Niaussat, P. et al., 1963)
809 On the development of oocytes in the Nauphoeta cinerea (Blattoidea) during x irradiation of the head. (Caprotti, M. et al., 1965)
824 The protection of the olive tree at the present time. (Melis, A., 1962)
838 Irradiation effects on spermatogenesis in the gypsy moth, Porthetria dispar (L.). (Rule, H.D., et al., 1965)
839 The effect of x rays on adult Hyalomma asiaticum. Communication I. (Sidorov, V.E., Grokhovskaya, I.M., 1964)

4. Developmental Stage Response. Delayed Development

805 Baldwin, W.F. RADIOSENSITIVITY OF FEMALE GERM CELL STAGES OF Dahlbominus. Mutation Res. 2, 6 (1965) 530-3.

Male progeny from females irradiated as adults showed approximately 5 times as many eye-colour mutations as those irradiated in the larval stage. Also, the frequency of mutants increased with age of the adult, being approximately twice as high at 108 h of age as at 12 h. This phenomenon has been attributed to a larger number of radiosensitive oocytes in the ovarioles of the older adults. A 1500 Ci ^{60}Co-source was used, and exposure rates of 100 R/min and 1000 R/min.

806 Baldwin, W.F., Shaver, E.L. DOSE FRACTIONATION AND RECOVERY FROM x RAYS IN Rhodnius. Can. J. Zool. 42 (1964) 515-8.

In Rhodnius prolixus, moulting delay is proportional to the radiation dose. Mitosis in the epidermis of this insect prior to moult is not initiated until the bug obtains a blood meal; thus, it is possible to irradiate the epidermis while all the cells are in interphase, and, by holding the insects in an unfed condition, to maintain the cells in this stage for periods up to several weeks or months. As daughter cells produced by division in the epidermis are responsible for forming the new cuticle, mitotic inhibition following irradiation is reflected directly in a delay in moulting after a blood meal. It was shown earlier that recovery from radiation damage, of the kind that leads to delay in moulting, does occur during interphase in the epidermis of Rhodnius; the present work was designed to investigate the effects of dose fractionation on recovery from x-irradiation in interphase cells. The different treatments were: single exposure to 6000 R; divided exposure to 3000 R + 3000 R; and a single exposure to 3000 R. When the dose was split, the second half was given immediately before feeding. The data showed that recovery from the radiation-induced damage which delays the moult in Rhodnius is related to the interval between irradiation and feeding. The rate of recovery was rapid during the first 16 h, as shown by the decrease of about two days in median moulting time in all groups during this comparatively short period. However, an interval of 250 h was required to produce a further comparable decrease in moulting time. After single and divided doses of 6000 R the rate of recovery was comparable with both treatments. In both cases, the median moulting time progressed from approximately 27 d at 0 time to 23 d at an interval time of 250 h. At intervals greater than 250 h, however, recovery from moulting delay continued in the groups irradiated with single doses of 6000 R, whereas, in the divided dose, the amount of recovery was the same at 2048 h as at 250 h. After a single dose of 3000 R, the median moulting time decreased rapidly, and at 250 h was equal to the value for non-irradiated controls. Thus the recovery from radiation damage, as shown by a decrease in moulting delay, occurred during mitotic interphase, when the epidermal layer of cells responsible for manufacturing the new cuticle was in a non-dividing state. The absence of cell division made it possible to demonstrate recovery processes in Rhodnius without the complications found in tissues composed of dividing and nondividing cells. Therefore, a cell given the first fraction of a dose is the identical cell that receives the second or subsequent doses. (NSA 19:1965,94)

807 Benschoter, C.A., Telich, J. EFFECT OF GAMMA RAYS ON IMMATURE STAGES OF THE MEXICAN FRUIT FLY. J. econ. Ent. 57 (1964) 690-1.

Previous studies have shown the feasibility of using radiation as a quarantine treatment for insect-infested products. They indicated that relatively small dosages of γ-rays applied to eggs and larvae of the oriental fruit fly Dacus dorsalis will prevent development beyond the pupal stage. The plausibility of using radiation in quarantine treatment was strengthened by results of dosage-mortality studies conducted to determine the effectiveness of γ-rays in preventing development of immature stages of the Mexican fruit fly Anastrepha ludens. At doses of 250-2000 R eggs about 1 d old were γ-irradiated (^{60}Co) and held in covered petri dishes at 77°F until hatch counts were made 7 d later. Mature larvae also were irradiated at similar doses, allowed to pupate, and mortality was based on the number of adult flies that later emerged. In addition, pupae 5-7 d old were exposed to radiation doses up to 25 000 R. A γ-ray dose of 50 000 R administered to 1 d old flies (requiring nearly 6 h exposure time) was only 50% lethal to both sexes over a 3 week period, indicating that adults were much more difficult to kill than the other stages. The order of susceptibility is larva > egg > pupa > adult. x-rays were equally lethal to this fly and followed the same order of susceptibility of the life stages. Dosages used in this study approximated the amounts of radiation needed to prevent subsequent development of each stage. For example, 50 000 R killed only 50% of the adult flies exposed, but adult flies surviving irradiation as eggs and larvae in mangoes were sterilized by a dose of only 1000 R. This suggested that commodities may be rendered safe from the quarantine standpoint by relatively small amounts of irradiation without concern for killing the insects outright. In this way a quarantine treatment schedule might be based on the minimum γ-ray dose which would prevent normal development of the particular insect stage or stages involved. (NSA 19:1965,13011)

808 Bubnov, V.D., Ivashkov, I.S. EFFECT OF BETA RAYS ON LARVAE OF DOMESTIC FLIES. Trudy nauchno-issled. vet. Inst., Minsk 24 (1964) 339-. (In Russian)

809 Caprotti, M., Cioci, M., Springhetti, A. ON THE DEVELOPMENT OF OOCYTES IN THE Nauphoeta cinerea (BLATTOIDEA) DURING x IRRADIATION OF THE HEAD. Radioter. Radiobiol. Fis. med. 20 (1965) 57-74. (In Italian)

x-irradiation of the head of the insect N. cinerea changed the development of the oocytes. Exposure to 10 000 R of adult N. cinerea or of fast-stage nymphs slowed the development of oocytes; 25 000 R radiation stopped the development of oocytes in adult N. cinerea through lesion of corpus allatum, and x-irradiation of N. cinerea head from the 5th - the 16th day after moulting increased the development of oocytes in adult N. cinerea as if the functions of corpus allatum were increased. (Auth.)

810 Clayton, F.E. GENETIC EFFECTS FROM SIMULTANEOUS IRRADIATION OF IMMATURE AND MATURE Drosophila virilis MALES. Genetics 52, 5 (1965) 1081-92.

Males, 2½-5 h and 6 h old, were x-rayed simultaneously with 500, 1000, 1500, and 2000 R. Progeny from two successive 24 h mating periods were checked for dominant lethals and translocations. The susceptibility of sperm bundles and motile spermatozoa was similar at all dosage levels as determined by dominant lethals and translocations from period 1. From period 2, dominant lethals and translocation rates increased following irradiation of immature males but decreased when mature males were treated; this occurred at all levels of radiation with the exception of the 500 R test, in which translocation rates for the 2 d were similar. (Auth. summary)

811 Cornwell, P.B. SUSCEPTIBILITY OF THE GRAIN AND RICE WEEVILS, Sitophilus granarius (L.) AND Sitophilus zeamais Mots.* TO GAMMA RADIATION. p. 1-18 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966**, 236p.

S. zeamais is more susceptible than S. granarius in all developmental stages to the killing and sterilizing effects of γ-radiation. Irradiated eggs and larvae of S. granarius are incapable of development to adults after 5600 rep; those of S. zeamais fail to develop after 4000 rep. Pupae and pre-emerged adults of S. granarius are not prevented from developing even at 20 000 rep. Complete mortality of S. granarius (S. zeamais) within 28 d (21 d) of emergence is obtained when stages in grain are treated with 11 200 rep (8000 rep). The survival curve for adult weevils is characterized by delayed mortality after irradiation. Immature stages are markedly susceptible to sterilization. A dose of 11 200 rep is completely sterilizing to adults of both species (0.03% progeny production). Substerilizing doses result in two breaks in adult fertility, 0-2 d and 9-15 d after irradiation. Tests with large populations indicate that 15 000 rep is marginal for effective control, allowing some residual fertility, whilst 16 500 rep is completely sterilizing which (16 000 rad) is therefore recommended for control of the grain and rice weevils in industrial application.

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* Previously known as Sitophilus oryzae (L.) (large strain).

** Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

812 Crossley, D.A. Jr., Shanks, M.H. RADIATION SENSITIVITY OF IMMATURE STAGES OF THE GIANT MILKWEED BUG. p. 58-59 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p.

Oncopeltus fasciatus (Dallas) was exposed to γ-radiation from a ^{60}Co source, at 14.4 rad/sec. Clutches of 20 eggs were given 0, 0.5, 1, 2, 4, 8, or 16 krad. Nymphs received an additional 32 and 64 krad. Subsequently, the insects were maintained at 75°F (16- h day). Comparatively low doses affected hatchability. 1-d-eggs after 500 rad showed > 50% hatchability reduction; no eggs hatched after 2000 rad; 8000 rad were required to halt all embryonic development. Older eggs (the stage duration is 5 d) are less sensitive. Adults showed a radiation response similar to the nymphal stages. The mean survival of adult controls was 26 d, reduced to 23 d after 8000 rad, and to 8 d after 16 000 rad, the major reduction in survival occurred in the vicinity of 8000 and 16 000 rad, as with nymphs. A radiation profile would therefore show little change in radiosensitivity except for the egg stages.

813 Elbadry, E.N. SOME EFFECTS OF GAMMA RADIATION ON THE POTATO TUBERWORM, Gnorimoschema operculella (LEPIDOPTERA: GELECHIIDAE). Ann. ent. Soc. Am. 58, 2 (1965) 206-9.

Eggs and newly hatched larvae survived dosages up to 9 krad. Immature stages that developed from irradiated eggs suffered retardation of development and reduction in size and weight, and the adult moths that emerged were structurally malformed. Females were in many ways more sensitive to irradiation than were males, and all dosages delivered to the eggs reduced the fecundity of the adults that developed from them. Dosages of 24-96 kR given to mature larvae prevented pupation; lesser dosages caused retardation of pupal development; and adult malformation started with dosages of 6 kR. Again adult fecundity was severely affected. Reduction in fertility of the eggs produced was most evident with females irradiated as 8-d-old pupae, but reduction in egg deposition was shown by those irradiated earlier in the pupal stage. The tendency for adults to be malformed also was more pronounced when early pupal stages were irradiated. Adults exposed to 24 kR shortly after emergence laid sterile eggs and those given 96 kR were sluggish, with all body movements diminished. (Auth.)

814 Erdman, H.E. DIFFERENTIAL RESPONSES OF GERM CELLS IN FLOUR BEETLES, Tribolium castaneum Herbst, DUE TO x-RAY DOSE, HYPOTHERMIA, SEX EXPOSED AND AGE. HW-SA-3747, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 12 Oct. 1964, 21p.

Day-old virgin flour beetles, T. castaneum, were x-irradiated with 0,500, 1000, 2000, and 4000 R. Ten replicates of control, male-, female-, and both-exposed mating combinations were established at 25, 29, and 32°C in 65-70% relative humidity. Each pair was given 5 g of acclimated food daily for 2 weeks. The number of fertile pairs and the number of F_1 adults were measured on the day of reproductive onset. Reproductive onset was delayed 2-3 d in females given 4000 R x-ray doses, but no delay was observed in exposed males. For both-exposed, a progressive delay was induced by 2000 or 4000 R. For male- or female-exposed groups irradiated from 29-32°C, no modification in reproductive onset was found, but a delay was evident at lower temperatures. The 2000 or 4000 R exposures and decreased temperatures synergistically delayed reproductive onset for both-exposed pairs. The number of fertile pairs after 4000 R were reduced in female-exposed groups more than in male-exposed groups. A saturation effect in both-exposed combinations at 29°C was indicated. x-ray doses of 2000 R and higher reduced productivity. Males were more productive after 4000 R than were females. Viability or lethality effects were additive when both sexes of mating combinations were exposed to 2000 or 4000 R. The modifications of the three parameters investigated for productivity are discussed from the standpoints of temperature effects, and dose effects on the degree of development, and differentiation of male and female germ cells. The dose-response curves were the multi-hit type, implicating chromosomal aberrations as the cause of altered productivity. (NSA 19: 1965, 43715)

815 Farrow, M.G., Ulrich, V. x-RAY AND GAMMA RAY IRRADIATION OF Mormoniella vitripennis. Acad. Sci. Proc. 35 (1964) 21-28. (BAg 28: 64, 105875)

816 Godwin, P.A., Rule, H.D., Waters, W.E. SOME EFFECTS OF GAMMA IRRADIATION ON THE GYPSY MOTH, Porthetria dispar. J. econ. Ent. 57, 6 (1964) 986-90.

Pupae and larvae of the gypsy moth, P. dispar (L.), were irradiated with a ^{60}Co γ-source. The effect of various dosages on pupal survival, adult longevity, mating success, egg numbers, egg viability, and F_1 survival are reported. The irradiation of pupae more than 9 d old with 20 000 R resulted in very few crippling defects of the treated insects and reduced egg hatch to a low level. (Auth.)

817 Gubicza, A., Molnar, I. THE EFFECT OF GAMMA IRRADIATION ON THE VARO RACE OF Bombyx mori. II. IRRADIATION OF EGGS IN THE EARLY AND LATE EMBRYONIC STAGES. Annls Inst. biol. Tihany 31 (1964) 3-13. (In Hungarian)

Results are summarized from a study of the effects of γ-radiation on the eggs of the silkworm, B. mori, exposed during various developmental stages, and on the morphology of the larvae and on the health and fecundity of adult moths hatched from irradiated eggs. (NSA 20: 1966, 18345)

818(2) Huque, H. SOME OBSERVATIONS ON THE EFFECT OF IONIZING RADIATION AGAINST DESERT LOCUST. Pakist. J. Sci. 15, 6 (1963) 267-70.

In experiments in Pakistan, hatching was prevented by exposing the eggs of Schistocerca gregaria (Forsk.) to 90 and 120 kR γ-radiation from a ^{60}Co source. When hoppers in the 2nd to 5th instars were exposed to doses varying from 2.5-7 kR, all died, and the mortality rate increased with the increase in dose. The rate of metabolism was affected, and the hoppers lived longer than normal for that particular stage but could not moult. When young adults were exposed to high doses varying from 15-120 kR, death occurred within 96 h. (From auth. summary)

819 Huque, H., Khan, M.A. POSSIBILITIES OF CONTROLLING Callosobruchus subinnotatus Pic (BRUCHIDAE) BY GAMMA RAYS. Fd Irrad. 4, 3 (1964) A2-A7.

Phaseolus aureus grain was used to culture C. subinnotatus. Effects of γ-radiation were studied on eggs, full grown grubs, newly formed pupae, and longevity and fecundity. Results are tabulated, and it is concluded that eggs, grubs, pupae, and adults of Callosobruchis can be controlled successfully with doses of 2.5 to 3, 5, 20, and 5 kR respectively. (NSA 18: 1964, 23270)

820 Lippold, P.C., Gambrell, F.L. EFFECTS OF IONIZING RADIATION ON EGGS AND ADULT INSECTS. Bull. ent. Soc. Am. 11, 3 (1965) 158. Abstr. 79. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Various levels and dosage rates of ^{60}Co irradiation were evaluated against egg and adult stages of the European chafer, milkweed bug, and plum curculio. Longevity, fecundity, feeding and hatch data were obtained from some of these species. (Abstr.)

821(2) Lukacsovics, F., Gubicza, A. THE EFFECT OF GAMMA RAYS ON "VARO" RACE OF Bombyx mori L. (LEPIDOPTERA). I. STUDY OF THE DIAPAUSE OF EGGS. Annls Inst. biol. Tihany 30 (1963) 67-72. (In Hungarian, with German summary)

822 Martin, A.O. STUDIES ON THE RATE OF SPERMATOGENESIS IN Drosophila: EFFECTS OF x-RAYS AND STREPTONIGRIN. Z. VererbLehre 96 (1965) 28-35.

The rate of spermatogenesis in adult Drosophila melanogaster was measured by use of ^{3}H-thymidine as a radioactive tracer. A comparison of the results for control and irradiated males revealed indications of a radio-induced lag. The time tables of spermatogenesis stages were identical for the first three broods. However, late spermatids appeared in brood four of the control group, but not until brood five in the irradiated flies. Mature sperm appeared in brood five of the control, but not until brood six of the x-rayed. Primary spermatocytes persisted longer in the streptonigrin-treated samples than in the controls. Also, the progress of cells through spermatogenesis was about 24 h faster in the adult testis as opposed to that of the immature testis. The results support the suggestion that x-rays effect a rate change in the progress of cells through spermatogenesis, as seen by comparison between the control and irradiated adult males. Two sets of evidence (one for larval and one for adult Drosophila) point to a retardation of the rate of gametogenesis induced by x-rays. (From NSA 19: 1965, 31889)

823 Mayer, M.S. BIOLOGICAL AND HISTOPATHOLOGICAL EFFECTS OF GAMMA RADIATION ON THREE LIFE STAGES OF Anthonomus grandis Boheman. Diss. Abstr. 25, 1 (1964) 43.

A study of the effects of γ-radiation on the boll weevil was accomplished in three major phases. The first phase tested the hypothesis that the amount of mating by boll weevils is a function of age and/or the length of time males and females are confined together. In this series of investigations the amount of mating in a 24 h interval was linearly related to the increase in age of the male and was not dependent upon the age of the female. The second phase of the study was designed to test the effect of γ-radiation on egg-hatch, pupal eclosion, and adult longevity. Adults from irradiated eggs and pupae were mated. Most of the dose-response curves were approximately sigmoid. Adults that developed from eggs and pupae that had been irradiated did not live as long as the control insects. Matings indicated that no dosage tolerated by an immature stage was sufficient to sterilize the resulting adult. However, 8000 R was found to be sufficient to sterilize adult males that were 12 and 36 h old at the time of treatment. Females treated with 8000 R laid virtually no eggs and died sooner than the controls. The third phase of research was a study of the histology of the testes, ovarioles, and midgut at various times after treatment with 8000 R. After treatment the testes decreased in size, and after 5 d they resembled a sac-like mass of sperm with few or no meiotic patterns visible. The nurse and follicle cells were affected most adversely in the female reproductive system. The effect on the midgut cells was an inhibition of mitosis within the regenerative nidi, with consequent slow degeneration of the midgut epithelium. (NSA 18:1964, 41216)

824(2) Melis, A. LA DIFESA DELL'OLIVO NELL'ATTUALE MOMENTO. (The protection of the olive tree at the present time). Redia 47 (1962) 1-79. (In Italian, with English summary)

Laboratory investigations on the effect of malathion on the nerve ganglia and the mesenteron of Dacus oleae showed that this product inhibits cholinesterase but does not cause morphological injuries such as result from γ-radiation at 12 000-20 000 R, and serious injuries resulted only from doses of 30 000 R or more. Adult emergence was prevented by doses of 35 000-50 000 R. In field tests on chemical control various chemicals were applied, including Ekatin (20% thiometon), dimethoate (Rogor), Dimecron (containing phosphamidon), diazinon, and sugar-bait sprays poisoned with sodium arsenite.

825 Nair, K.S.S., George, J.C. EFFECTS OF GAMMA RADIATION ON THE POSTEMBRYONIC STAGES OF A DERMESTID BEETLE, Anthrenus vorax Waterhouse. Entomologia exp. appl. 8, 4 (1965) 241-48.

The postembryonic stages of Anthrenus flavipes Lec. (vorax Waterh.) proved susceptible to γ-radiation in doses of 5, 10, 15 and 20 krad. Pupation was more or less completely inhibited, but some larvae pupated after repeated moults, reduction in size and regrowth and gave rise to normal adults. The percentage of successful moults decreased with increasing doses. At the lower doses, more last-instar larvae died in the prepupal stage; at the higher ones, mortality in the larval stage was higher. Irradiation of the early prepupa hampered the pupal moult; that of the late prepupa did not but produced certain malformations in the adult. In the pupal stage, the later the pupa was irradiated, the less susceptible it was, radiation being more harmful during the first three days after pupation than later. Pre-emergent adults and pupae, 5-6 d old, were exposed to different doses of radiation, and data on the fecundity and fertility of the various mating combinations of irradiated and non-irradiated males and females are presented and discussed. (From auth.)

826(2) Ooi, H. STUDIES ON THE EFFECT OF GAMMA-RAYS IRRADIATION AT EMBRYONIC STAGES UPON THE LARVAL AND COCOON CHARACTERS IN THE SILKWORM. Nippon Sanshigaku Zasshi (J. seric. Sci., Tokyo) 30, 5 (1961) 401-4.

827(1) Podolyan, V.Y. THE BIOLOGICAL EFFECT OF RADIOACTIVE COBALT (^{60}Co) ON THE PREIMAGINAL STAGES OF THE CARRION FLY Protophormia terrae novae R.D. Tezisÿ Dokladov 3-go Soveshchaniya Vsesoyuznogo Entomologicheskogo Obshchestva. 1957. No pagination.

828(1) Podolyan, V.Y. THE BIOLOGICAL EFFECT OF RADIOACTIVE COBALT (^{60}Co) ON THE PREIMAGINAL STAGES OF THE CARRION FLY Protophormia terrae novae R.D. Trudȳ voenno-med. Akad. RKKA 105 (1959). No pagination.

829 Potts, W.H. THE GAMMA IRRADIATION OF Glossina PUPARIAL STAGES AND CONTROL. p.254-55 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul.1964" Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

The number of flies emerging from the puparia was not affected by irradiation at doses of 3000, 6000 or 12 000 rep, given at 6000 R/h, but it was halved by a dose of 30 000 rep, given at 6000 R/min. There was no impairment of the vigour of the males that had been subjected to the dose of 6000 rep, as shown by their ability to compete successfully for females with untreated males; however, their length of life was about halved. Observation of the routine matings showed that males treated at this dose mated just as readily as the untreated ones, and males were observed to couple with the females from 10-91 d after irradiation had been effected. In view of the slow reproduction rate of the fly, the collection of wild puparia for irradiation is proposed. Further investigations are essential to determine: 1. Whether the degree of sterilisation of Glossina can be increased, without decreasing the length of life of the male, by use of repeated small doses of γ-radiation; 2. Confirmation that any residual fertility of the males that may remain, after the maximum sterilisation possible without undue decrease in the length of life of the male, will result in only a reduced female productivity; 3. Confirmation of a complete, or nearly complete, sterilising effect on the female; 4. Determination of the stage of puparial development at which irradiation (a) has the greatest sterilising effect, on both sexes, and (b) has the least effect in shortening the life of the male. 5. Exploration of the effect of doses below those needed for sterilisation, to determine whether dominant lethal genes may be produced in F_1 and F_2 generations.

830 Qureshi, Z.A., Mills, R.B., Wilbur, D.A. SENSITIVITY OF VARIOUS STAGES OF Angumois GRAIN MOTH TO GAMMA RADIATION. Bull. ent. Soc. Am. 10, 3 (1964) 163. Abstr. 60.

The effects of γ-radiation on the eggs, larvae, prepupae, and pupae of known ages have been determined. The results regarding the viability of eggs, emergence, structural abnormality, fertility and longevity of adults are reported.

831 Qureshi, Z.A., Wilbur, D.A., Mills, R.B. EFFECTS OF GAMMA RADIATION ON EARLY, INTERMEDIATE AND LATE LARVAE OF Angumois GRAIN MOTH. Bull. ent. Soc. Am. 11, 3 (1965) 158. Abstr. 80. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

Three stages of Sitotroga cerealella larvae were exposed to doses of γ-radiation between 2 and 25 kR. Larval mortality and developmental period and adult weights, structural abnormalities, fecundity and fertility are reported. (Abstr.)

832 Qureshi, Z.A., Wilbur, D.A., Mills, R.B. EFFECTS OF GAMMA RADIATION ON PREPUPAE AND PUPAE OF Angumois GRAIN MOTH. Bull. ent. Soc. Am. 11, 3 (1965) 158. Abstr. 81. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec. 1965".

Prepupae and pupae (early and late) of Sitotroga cerealella were exposed to doses of γ-radiation between 3 and 25 kR. Effects on pupal survival and length of development and adult structural abnormalities, weight, fertility and fecundity are reported. (Abstr.)

833 Ratty, F.J. ESTIMATION OF SENSITIVITY OF Drosophila melanogaster LARVAE TO IRRADIATION USING A THIRD-ORDER ROTABLE DESIGN. p.19 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

834 Reichle, D.E. RADIATION PROFILE OF THE EVERGREEN BAGWORM. p.56-58 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p;

Eggs of Thyridopteryx ephemeraeformis (Lepidoptera), in sets of 25, were exposed to 14.4 R/sec from a ^{60}Co γ-source, at dose levels of 100 (2^n), where n = 1, 2 ... 9, and at increasing time intervals after breaking dormancy. It was thus possible to analyse dose-age interactions. A graph involving 4000 individuals was plotted, the number of individuals hatching at each dose level being expressed as a percentage of the controls for that egg stage. Mean hatching time for control was 14 ± 0.07 d, mean percentage hatching 82.0 ± 3.9. 2-d-eggs did not hatch at doses ≥ 1600 rad while 25 600 rad were required to prevent hatching of 3-to 12-d-eggs. Eggs thus appear to be ~16 times more radiosensitive during early embryonic development than in stages immediately preceding hatching. 1-d-old larvae were 4 times more resistant than pre-hatch eggs. Eggs in the dormant state may not be as radiosensitive as those in initial stages of development. 1-d eggs showed a significant decrease in hatching at 400 rad, while 8-d-eggs to day-old larvae were unaffected by doses below 3200 rad. Alterations in normal behavioral patterns were detectable in the larval stage (e.g. the construction of a larval case or "bag", within 1-2 d after hatching was impaired at certain dose levels. The enhancing effect on hatching of low doses needs verifications. - The greater part of the life cycle (October-April, or about 60% of total time) is passed in the egg stage, i.e. the most radiosensitive stage.

835 Riordan, D.F. EFFECTS OF LOW-LEVEL GAMMA-RADIATION ON THE IMMATURE STAGES OF Dahlbominus fuscipennis (Zett.) (HYMENOPTERA: EULOPHIDAE). Can. J. Zool. 42 (1964) 675-84.

The experiments were designed to provide data on the effects of relatively low radiation doses administered at low rates. Immature stages of the chalcid were irradiated for 24 h on each of the first 16 d of development at dose rates of 12, 24, and 48 R/h. The numbers of females available to be mothers of the F_2 generation was calculated to be reduced by 94%, 84%, and 42%, respectively, at the three rates of dosage when irradiation was commenced within 24 h after oviposition. The greatest damage was produced by irradiation at 48 and 24 R/h during days one, two, or three when the insects are eggs or very young larvae or when hatching would be taking place. After day three, resistance rose steadily until it reached a peak coinciding with the late larval stage, which is probably a time of developmental rest. Resistance to irradiation at all dosages decreased through the pupal stages, in fact, for the 12 R/h dosage the lowest survival values were reached on days 14-16. The numbers of male adults from unmated mothers showed some reduction from irradiation at 48 R/h, notably for irradiation days one, two, and three when the numbers were reduced to 67, 49, and 67%, respectively, as compared with the non-irradiated controls. There was evidence of another effect, namely, that irradiation lowered the vitality of the ensuing all-male populations, as in many cases they failed to emerge from the host cocoons. Females irradiated at immature stages failed to parasitize the hosts provided (Neodiprion), and examinations of hosts from which no parasites emerged failed to reveal the presence of unhatched eggs or dead larvae. Thus it is considered that complete sterilization of some females occurred, and many females not sterilized laid fewer viable eggs than the controls. The only effect definitely demonstrated in those males surviving irradiation in the immature stages was complete sterility. A prominent effect on the progeny of irradiated mated mothers was an increase in the average numbers of male progeny. (From NSA 19: 1965, 95)

836 Rockstein, M., Dauer, M., Bhatnagar, P.L. ADULT EMERGENCE OF THE HOUSE FLY, Musca domestica, FROM x-IRRADIATED PUPAE. Ann. ent. Soc. Am. 58, 3 (1965) 375-9.

Pupae of the house fly, M. domestica L., when exposed to single doses of x-rays, varying between 10 000-30 000 rad, show a correlation between dosage and emergence. At 10 000 and 15 000 rad 90.1% - 73.9% of the flies, respectively, emerge. This figure declines to 42.5% at 20 000 and 19.5% at 30 000 rad. The number of flies dying in the pupal stage correspondingly increases with an increase in radiation dose. The implications of these results are discussed. (Auth.)

837 Rockstein, M., Dauer, M., Bhatnagar, P.L. EFFECT OF x-IRRADIATION ON EMERGENCE OF ADULT HOUSE FLIES. Bull. ent. Soc. Am. 10, 3 (1964) 166. Abstr. 116.

Exposure of 2500 1- to 2-d-old pupae to 10 000 rad resulted in 90% emergence and 2% partial emergence; 15 000 R - 74% emergence and 17% partial emergence; 20 000 R - 43% emergence and 18% partial emergence; 30 000 R - 20% emergence and ½% partial emergence.

838 Rule, H.D., Godwin, P.A., Waters, W.E. IRRADIATION EFFECTS ON SPERMATOGENESIS IN THE GYPSY MOTH, Porthetria dispar (L.) J. Insect Physiol. 11, 4 (1965) 369-78.

In connexion with a detailed study of the effects of γ-irradiation on the gypsy moth, histological examination was made of normal larvae in instars I to V and pupae to determine the timing and sequence of spermatogenesis. Similar examination was made of pupae that had been irradiated as instar IV and V larvae with dosages ranging from 500-20 000 R. Spermatogenesis occurred in the larval period, and meiotic activity began in instar IV. Fully formed spermatozoa were first observed in instar V. The appearance of gonadal tissues of treated and untreated specimens in the pupal stage is described. All irradiation dosages caused some cytological damage; instar IV larvae exposed to 20 000 R died in 7-10 d. The major gross effects of irradiation were: degeneration of germinal cysts, shattering of sperm bundles within the follicles, plugging of the entrance to the vas deferens by interstitial and other tissue (this occurred with higher dosages only), thickening of testes walls and septa and of the vas deferens, and clumping of fat-body cells around the testes. One or more of these morphological changes might be related to the sterile condition. (Auth.)

839 Sidorov, V.E., Grokhovskaya, I.M. THE EFFECT OF x-RAYS ON ADULT Hyalomma asiaticum. COMMUNICATION I. Medskaya Parazit. 33, 5 (1964) 560-63. (In Russian, with English summary)

Hungry adult ticks (H. asiaticum) were irradiated with 200, 400, 800, 1500, 3000, 6000, and 12 000 R/min. Each group included 50 males and 50 females. None of the doses was lethal, and the main funtions (feeding, digestion, excretion, growth) were not affected. Ticks receiving doses from 200-3000 R did not lose the ability to suck blood. Copulation took place during sucking. Females in the 3000 R group did not lay eggs but lived up to 6 months after satiation. Those that received smaller doses laid eggs. Oviposition was reduced throughout. Larvae developed from eggs laid by females receiving doses only up to 800 R. Doses greater than 1500 R completely destroyed the function of the ovaries. It was concluded that doses of 3000 R and above may be used in tick control.

840 Stark, R.W. EFFECTS OF ACUTE DOSES OF GAMMA RADIATION ON TWO FOREST INSECTS. Presented at the "Meeting of the American Institute of Biological Sciences, Denver, Colo., Aug. 1964".

For abstract, see 843.

841 Stark, R.W., Wood, D.L. EFFECTS OF ACUTE DOSES OF GAMMA RADIATION ON TWO FOREST INSECTS. Bull. ecol. Soc. Am. 45 (1964) 106. Abstr.

For abstract, see 843.

842 Stark, R.W., Wood, D.L. THE EFFECT OF GAMMA RADIATION ON THE SAWFLIES, Neodiprion fulviceps, COMPLEX. "48th Annual Meeting-Pacific Branch-of the Entomological Society of America, Long Beach, Calif., 16-18 Jun. 1964".

For abstract, see 843.

843 Stark, R.W., Wood, D.L. THE EFFECTS OF GAMMA RADIATION ON THE BIOLOGY AND BEHAVIOR OF FOREST INSECTS AND THE POSSIBILITY OF THEIR CONTROL. AED-CONF. 1964-158-5, Gmelin-Institut für Anorganische Chemie und Grenzgebiete, Frankfurt am Main (West Germany). Presented at the "15th Annual Meeting of the American Institute of Biological Sciences, Boulder, Colo., 23-28 Aug. 1964".

Sterilization of adult males and female Ips confusus (Coleoptera: Scolytidae) exposed to γ-radiation as newly emerged adults was almost complete at 7500 R and 10 000 R, respectively. Male mating behaviour (sperm transfer, gallery pattern) was unaffected by dosages up to 60 000 R, and so, essentially, was the capacity of either sex to establish galleries. Longevity was reduced by > 5000 R. LD50 for males occurred after 11.5 d at 7500 R (29 d in controls). Mortality of progeny resulting from males irradiated at sub-sterilization levels was higher than in the controls. The dosage to achieve significant population reduction with minimum effect on longevity and other biological activity is believed to be approximately 7500 R. It was concluded that irradiation of feeding stages of the sawfly, Neodiprion fulviceps (Hymenoptera: Diprionidae) for sterilization was not practical. Differences in development, feeding behaviour and cocoon formation were caused by ≥20 000 R. Exposure in the cocoon (pre-pupae and pupae) was successful to some extent. Oviposition was retarded at all radiation levels and eclosion of eggs from irradiated adults was low. – The sterilization technique may have promise in the control of bark beetles. The necessity for rearing large numbers on artificial media could be circumvented by mass trapping utilizing their natural sex attractant and by mass rearing in cut host material in the laboratory.

844 Teulade, P. VARIATIONS DE LA SENSIBILITE AUX RAYONS X DES ŒUFS DE Bombyx mori, EN FONCTION DU DEVELOPPEMENT EMBRYONNAIRE ET DE LA DUREE D'HIVERNATION. Thesis. Troisième cycle Faculté des Sciences Lyon. (1964) 103p.

845 Teulade, P. IRRADIATION CONTINUE A FAIBLE DEBIT DE DOSE DES ŒUFS DE Bombyx mori, ET NOTION DE DEBIT DE DOSE EFFICACE. J. Insect Physiol. 11, 4 (1965) 379-86. (With English summary).

When the eggs of the silkworm B. mori are submitted to low-level continuous γ-radiation from ^{60}Co at the dose-rates of 15 and 37 R/h, one finds that: (1) for a similar total dose delivered at aforementioned dose-rates, the effects with 37 R/h are more pronounced than those with 15 R/h, and (2) the time of development and the mortality increase as a linear function of the dose. The recovery takes place during irradiation and partly counterbalances the lethal effect of radiations, so limiting the efficient dose-rate. Therefore, only a fraction of the total dose delivered in a continuous low-level irradiation is active. This explains the significance of the dose-rate. The linear relationship between the total dose and the effects seems the result of a combination between the efficient dose-rate and the fluctuations of radiosensitivity in relation with the embryonic development. (Auth.)

846 Tilton, E.W., Brower, J.H. IRRADIATION STUDIES WITH INSECTS INFESTING BULK-GRAIN AND PACKAGED COMMODITIES. TID-22414, Stored-Product Insects Research and Development Lab., Savannah, Ga., 28 Oct. 1965, 6p.

γ-radiation effects on grain beetles, the merchant grain beetle Oryzaephilus mercaptor and the confused flour beetle, Tribolium confusum, and on almond months, Ephestia cautella, were investigated. For each treatment, 30 individuals (each in a closed gelatin capsule) of each stage (egg, larva, pupa, and adult) were used for each replicate. Dosage levels included: 0, 10, 20, 30, 50, and 100 krad. Following irradiation, virgin adults were paired with non-irradiated virgin adults from the same original populations for sterility studies. Preliminary results indicated that mortality was high for all stages at all treatment levels.

847 Tobias, C.A. STUDIES ON HEAVILY IONIZING PARTICLES – HILAC STUDIES. p.12 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

848 Valencia, R.M., Valencia, J.I. THE RADIOSENSITIVITY OF MATURE GERM CELLS AND FERTILIZED EGGS IN Drosophila melanogaster. p.345-60 in "Mammalian Cytogenetics and Related Problems in Radiobiology". New York, Pergamon Press. 1964.

See also:

527 The effect of x-irradiation on spermatogenesis in Drosophila melanogaster Meigen. (Abro, A., 1964)
641 Susceptibility of the saw-toothed grain beetle, Oryzaephilus surinamensis (L.) to gamma radiation. (Jefferies, D.J., 1966)
647 Lethal and sterilising effects of cobalt-60 gamma rays on Argyroploce leucotreta. (Myburgh, A.C., 1963)
657 The effect of γ-irradiation on fecundity and fertility of Tribolium confusum Duval. (Vereecke, A., Pelerents, C., 1965)
675 x-ray and fast neutron effects on productivity of flour beetles. (Erdman, H.E., 1965)
774 Uric acid in normal and γ-irradiated eggs of Bombyx mori. (Lassota, Z., 1965)
775 Oxygen uptake and ammonia release in normal and γ-irradiated eggs of Bombyx mori. (Lassota, Z., 1965)
778 Oxygen uptake of three life stages of Tenebrio molitor prior and subsequent to massive doses of low energy x-rays. (Neidinger, J.W. et al., 1965)
781 Effect of ionizing radiation on the endocrine system in insects. (Piechowska, M.J., 1965)
782 Effect of x-rays on the meal worm, Tenebrio molitor, embryo. I. Changes in the protein and free A-amino nitrogen fraction. (Po-Chedley, D.S., 1964)
783 The effects of x-rays on the meal worm, Tenebrio molitor, embryo. (Po-Chedley, D.S., 1965)
784 Temporal pattern of the early stages of spermatogenesis of adult Drosophila melanogaster males after treatment with x-rays. (Puro, J.A., 1961)
787 Genetic effects of gamma-irradiation on egg production and adult emergence of Drosophila melanogaster. (Touchberry, R.W., DeFries, J.C., 1964)
791 Study of the post-embryonic development of the ovary in Ephestia kühniella Z. (Lepidoptera, Pyralidae). I. Effect of ionizing radiations. (Baroughi-Bonab, H., 1965)
795 Action de la pars intercerebralis sur le développement de Locusta migratoria L. (Girardie, A., 1964)
849 x-irradiation of pupae of the house fly Musca domestica L., and adult survival. (Bhatnagar, P.L. et al., 1965)
850 Influence des rayons x au cours de l'embryogénèse de Gryllus domesticus L. (Orthoptère). (Bluzat, R., 1964)
853 x-irradiation of pupae of the house fly, Musca domestica L., and male survival. (Dauer, M. et al., 1965)

854 The effects of gamma radiation on the fertility and longevity of Hippelates pusio (Flint, H.M., 1965)
858 Radiation sensitivity of insects. (Menhinick, E.F., Dodson, G.J., 1964)
871 Egg mortality after gamma irradiation of adults of the omnivorous leaf roller. (Jacklin, S.W. et al., 1965)
874 Susceptibility of Callosobruchus maculatus to high dose rate gamma irradiation. (Neharin, A. et al., 1965)
877 Effects of ionizing radiation on pests in cereals. II. Effects of cobalt-60 radiation on Tyroglyphus farinae mites. (Szyszko, E. et al., 1962)
887 A comparison of the susceptibility of the grain weevil Sitophilus granarius (L.) to accelerated electrons and ^{60}Co gamma radiation. (Bull, J.O., Cornwell, P.B., 1966)
889 Effect of low temperature on radiosensitivity of Drosophila pupae. (Giavelli, S., Parazzi, E., 1963)
898 Relative biological effectiveness of 14.1 MeV fast neutrons in killing dormant silkworm eggs. (Murakami, A., Kondo, S., 1963)
900 The effect of rearing medium on the susceptibility of Tribolium confusum Duv. and Sitophilus granarius (L.) to gamma radiation. (Shipp, E., 1966)
901 Oxygen dependence for radiation sensitivity during development in insects. (Slater, J.V. et al., 1964)
902 Heavy ion localization of sensitive embryonic sites in Tribolium. (Slater, J.V. et al., 1964)
920 Fast neutron effects on flour beetles. (Erdman, H.E., 1964)
921 Fast neutron effects on productivity of young and old flour beetles, Tribolium castaneum Herbst and alterations due to temperature and sex exposed. (Erdman, H.E., 1964)
924 A study of radiation on the biology and population dynamics of the cereal leaf beetle, Oulema melanopa (L.) order Coleoptera, family Chrysomelidae. (Myser, W.C., 1965)
925 Effect of continuous low-level gamma-irradiation on successive generations of Dahlbominus fuscipennis (Zett.) (Hymenoptera: Eulophidae). (Riordan, D.F., 1964)
927
Long term effects of acute low-level x-rays on the population dynamics of the yellow fever mosquito, Aëdes aegypti. (Willard, W.K., 1965)
928
996 Sterilization of the navel organgeworm, Paramyelois transitella (Walker), by gamma radiation (Lepidoptera: Phycitidae). (Husseiny, M.M., Madsen, H.F., 1964)
1013 Radiation treatment of grain and grain products. (Henderson, L.P., 1964)
1031 The killing of silkworm pupae and the preservation of silkworm cocoons by gamma rays. (Kipiani, R.Ya., Tsetskhladze, T.V., 1957)
1032 The killing of cocoons by irradiation from radioactive sources. (Molnar, I. et al., 1963)
1033 A study of silk cocoons from the eggs of Bombyx mori L. irradiated with Co^{60}. (Molnar, I. et al., 1964)

5. Malformations. Histopathological Changes

See:

659 The potential application of γ-radiation for the sterilization of Chloridea obsoleta for the purpose of reducing its population. (Andreev, S.V. et al., 1964)
798 The effects of x irradiation on the embryos of invertebrate embryos. (Larsen, W., 1965)
799 Influence of radiation on ovarian maturation and histolysis of pupal fat body in diptera. (Monro, J., Bailey, P.T., 1965)
813 Some effects of gamma radiation on the potato tuberworm, Gnorimoschema operculella (Lepidoptera: Gelechiidae). (Elbadry, E., 1965)
816 Some effects of gamma irradiation on the gypsy moth, Porthetria dispar. (Godwin, P.A. et al., 1964)
817 The effect of gamma irradiation on the varo race of Bombyx mori. II. Irradiation of eggs in the early and late embryonic stages. (Gubicza, A., Molnar, I., 1964)
823 Biological and histopathological effects of gamma radiation on three life stages of Anthonomus grandis Boheman. (Mayer, M.S., 1964)

826 Studies on the effect of gamma-rays irradiation at embryonic stages upon the larval and cocoon characters in the silkworm. (Ooi, H., 1961)

901 Oxygen dependence for radiation sensitivity during development in insects. (Slater, J. V. et al., 1964)

6. Senescence. Longevity. Fitness

849 Bhatnagar, P.L., Rockstein, M., Dauer, M. x-IRRADIATION OF PUPAE OF THE HOUSE FLY Musca domestica L., AND ADULT SURVIVAL. Expl Geront. 1 (1965) 149-59.

Longevity data were obtained to determine the nature of the structural and functional derangements induced in the normally aging house fly adults, following x-irradiation of the pupae. At 36 - 48 h following pupation, the pupae were exposed to x-rays in single doses at the rate of 2000 rad/min at 250 kVp. It was found that the ratio of male to female is almost 1:1 in the control flies, whereas the ratio shifts in favour of the males as radiation dosage is increased (the ratio was 1.35:1 after 20 000 rad). The adults which emerged from the x-irradiated pupae did not show any structural abnormalities and appeared to be otherwise normal. Abrasion of wings, a normal aging concomitant in male house flies especially, was observed only in the flies emerging from the pupae previously exposed to doses of 20 000 rad or lower. At 30 000 rad, no wing loss was observed. Moreover, all flies emerging from previously irradiated pupae failed to lay any eggs. The median life span of the males emerged from the pupae exposed to 10 000 rad was 15 d and that of the females was 18 d. Thus, in comparison to the control, the life span of the male increases by 3 d and that of the female shortens by 3 d, so that thenegative skewedness of the female survival curve is equal to the positive skewedness of the male survival curve. Comparison of the mean survival periods of each revealed that the differences were highly significant. However, x-irradiation of 10 000 rad did not alter the value of the total life span of the flies significantly. (NSA 20:1966, 5331)

850 Bluzat, R. INFLUENCE DES RAYONS X AU COURS DE L'EMBRYOGENESE DE Gryllus domesticus L. (ORTHOPTERE). Bull. soc. Zool., France 89, 4 (1964) 478-95.

851 Crenshaw, J.W. RADIATION-INDUCED INCREASES IN FITNESS IN THE FLOUR BEETLE Tribolium confusum. Science, N.Y. 149 (1965) 426-7.

Polygenic mutations were induced in an inbred strain of T. confusum by exposure to 500 R of γ-radiation. Female progeny of irradiated males bearing induced mutations in the heterozygous state produced significantly more viable offspring than control female progeny of non-irradiated males. (Auth.)

852 Dauer, M., Bhatnagar, P.L., Rockstein, M. FACTORS IN LONGEVITY EFFECTS OF HIGH-ENERGY RADIATION ON THE SURVIVAL OF MALE HOUSE FLIES. Bull. ent. Soc. Am. 10, 3 (1964) 166. Abstr.

x-radiation doses of 10 000 or 15 000 rad to 1- to 2-d-old pupae increased the average life span of populations of 2500 male house flies; 20 000 rad doses had no appreciable effect on male life span; 30 000 rad shortened the average male life span markedly.

853 Dauer, M., Bhatnagar, P.L., Rockstein, M. x-IRRADIATION OF PUPAE OF THE HOUSE FLY, Musca domestica L., AND MALE SURVIVAL. J. Geront. 20, 2 (1965) 219-23.

The survival of male house flies was studied after exposure of 36- to 48-h-old pupae to dosages of x-rays ranging from 10 000 - 30 000 rad. All males which emerged successfully from the irradiated pupae appeared normal. A comparison of the rate of mortality at various dosage levels indicated that the average life span of male flies was increased by exposure of pupae to 10 000 - 15 000 rad, remained unchanged at 20 000 rad, and declined significantly after exposure to 30 000 rad. Wing loss, a normal concomitant of aging in males up to 2 weeks of adult life, was only observed in the flies which emerged from the pupae exposed to x-rays dosages up to 20 000 rad. At exposure to 30 000 rad, normal wing loss was completely repressed. (From auth. summary)

854 Flint, H.M. THE EFFECTS OF GAMMA RADIATION ON THE FERTILITY AND LONGEVITY OF Hippelates pusio. J. econ. Ent. 58, 3 (1965) 555-9.

Males and females of Hippelates pusio Loew were treated in the adult and pupal stages with ^{60}Co γ-radiation. A dose of 5000 R reduced egg viability to < 1% when adults of either sex were treated 24-36 h after emergence. In the late pupal stage, a dose of 4500 R was able to sterilize both sexes. Some recovery of fertility was found in males treated as pupae after about 3 weeks. The sterilizing dose levels caused no increased mortality during the test period. Adults were treated with massive doses of radiation and death was obtained within 3 d with 135 000 R. (Auth.)

855 Lamb, M.J. THE EFFECTS OF RADIATION ON THE LONGEVITY OF FEMALE Drosophila subobscura. J. Insect Physiol. 10 (1964) 487-97.

The longevity of adult male and virgin female D. subobscura exposed to single doses of x-rays 4-8 d after eclosion was investigated. When kept on a maize meal-agar-molasses medium which was replaced every 4 d, males showed a nearly linear reduction in lifespan with increasing dose; females showed an increase in lifespan after doses of 8500, 17 000, or 34 000 R. Evidence is given that this increase in longevity is correlated with a decrease in fecundity after irradiation. When females were kept on a medium containing no maize meal but a higher proportion of molasses, or when they were given fresh food every 2 d instead of 4 d, no large increase in lifespan after irradiation was found. It is suggested that there is an interaction between nutrition, egg production, and longevity, and that x-radiation will prolong the lifespan of females only if they are kept in nutritionally suboptimal conditions. (Auth.)

856 Lamb, M.T., Smith, J.M. RADIATION AND AGEING IN INSECTS. Expl Geront. 1, 1 (1964) 11-20.

857 Maynard-Smith, J. THE CAUSES OF AGEING. Proc. R. Soc. B 157 (1962) 115-27.

A section dealing with radiation and ageing (p. 123-4) also considers some data obtained with Habrobracon. The life-shortening caused by radiation is considered to be, at least in part, due to the induction of recessive somatic mutations.

858 Menhinick, E.F., Dodson, G.J. RADIATION SENSITIVITY OF INSECTS. p. 76 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct. 1964.

Five species of insects were irradiated in a ^{60}Co-source at 3 or 30 kR/min, and given total doses of 1-512 kR in 100% increments. Insects were maintained at 28°C. Doses of 512 kR were immediately lethal to all species examined; 2 kR or less did not affect survival. Mean survival time plotted against the log of dose was essentially a straight line. Crickets (Acheta domestica) were the most sensitive insects, 1st and 2nd instar crickets, being more radiosensitive than adults. Radiation profiles of grain beetles (Tenebrio molitor) showed pupae to live longer than adults or larvae at doses > 16 kR, but small larvae were more radioresistant at doses < 8 kR (perhaps a function of their greater life expectancy). Milkweed bugs (Oncopeltus fasciatus) and roaches (Parcoblatta sp.) had a mean survival time similar to Tenebrio. Ants (Formicidae sp.) were the most resistant species examined.

859 Menhinick, E.F., Dodson, G.J. RADIATION PROFILE OF INSECTS. p. 55-56 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p.

The European brown cricket, Acheta domestica, and the yellow mealworm, Tenebrio molitor, were exposed to γ-radiation from a ^{60}Co-source, at 3 or 30 kR/min, giving a total of 1-512 kR in 100% increments, at 28°C. The effects were expressed as mean life expectancy. Generally, the mortality curves consisted of three components: (1) a slight increase in life expectancy at low doses; (2) a sharp decline at slightly higher doses; and (3) a gradual decline at increasingly higher doses.

860 Menhinick, E.F., Dodson, G.J. EFFECT OF BETA IRRADIATION ON INSECTS. p. 59-60 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct. 1965, 263p.

insects were placed on the source, where the air dose was 3600 rad/h. They were given doses from 877-224 000 rad in 100% increments. Various sizes of nymphs of Acheta domestica, Tenebrio molitor, Periplaneta americana, and Blattella germanica were used. The insects were irradiated at room temperature, and kept at 28°C after irradiation. Effects were expressed as median life expectancy, corrected for control mortality. The gut does not appear to be a primary critical organ which probably lies closer to the skin. Dosages of 3600 rad/h of β- and 25 000 rad/h of γ-radiation were given in one experiment on large Acheta nymphs, when insects exposed to β-radiation were found to live twice as long as those exposed to an equivalent dose of γ-radiation. These findings are discussed.

861(2) Narayana, E.S., Chawla, S.S., Ghai, S. EFFECTS OF GAMMA RAYS ON MORTALITY, LONGEVITY AND FECUNDITY OF SOME SPECIES OF FRUIT FLIES. Proc. natn. Acad. Sci. India B, 29 (1963) 613-21.

The effects of γ-rays on mortality, longevity, and fecundity of some species of fruit flies showed that: the 2-d-old pupae were very susceptible to the rays as exposure to 2000 R brought 100% mortality in both the species studied; the resistance to the rays progressively increased with age; the fecundity was inversely proportional to the dosage used; the sterilizing effect started at ~2000 R in the adults emerging from 4-to 5-d-old pupae; and there was no apparent effect on the F_1 generation emerging from 1000 R-exposed pupae. (Auth.)

862 Nöthel, H. DER EINFLUSS VON RÖNTGENSTRAHLEN AUF VITALITÄTSMERKMALE VON Drosophila melanogaster. I. UNTERSUCHUNGEN ÜBER DIE LEBENSDAUER. (The influence of x-radiation on the vitality characteristics of Drosophila melanogaster. I. Investigations on the lifetime). Strahlentherapie 126 (1965) 269-82. (In German)

The influence of x-rays (100 kV, 17 different doses ranging from 0 - 125 kR) on the viability of insect imagoes was studied by means of the lifespan of D. melanogaster. Compared with the un-irradiated controls, a prolongation of female lifespan was apparent, which had a maximum of 50% at 11 kR. It was correlated with, and apparently due to the radioinduced sterilization. This was confirmed furthermore, especially with chemically (by TEM) sterilized females. With increasing dose, log mean survival time decreased linearly and parallely in both sexes, except the increase mentioned; the LD50 is 46 kR in males and 96 kR in females. There was a normal distribution of the mortality rate in the time after exposition at each dose. Therefore, it is assumed, that always the same mechanism of damage is involved. At doses above 90 kR this mechanism was overlapped by an immediate death, as indicated especially by the appearance of an additional early mortality peak. The immediate death was identical in both sexes. According to the symptoms, it is interpreted as central nervous injury. (Auth.)

863 Sakka, M. RADIATION INDUCED SHORTENING OF LIFE OF Sarcophaga peregrina AND ITS MODIFICATION BY DOSE FRACTIONATION. Nippon Igaku Hoshasen Gakkai Zasshi (Nippon Acta radiol.) 24, 11 (1965) 1185-88. (In Japanese)

Life shortening of adult Sarcophaga is one of the major late effects of radiation delivered at the pupal stage. The effects were proportional to the dose, with a threshold of several hundred roentgens. Dose fractionation reduced the effects, suggesting that late effects such as life shortening are associated with acute irradiation.

864 Sakka, M. x-RAY INDUCED SHORTENING OF LIFE SPAN OF ADULT Sarcophaga peregrina AND ITS MODIFICATION BY DOSE FRACTIONATION. Tohoku J. exp. Med. 86 (1965) 325-33.

The life span of the adult flies was diminished after x-irradiation in the early pupal stage, and imago formation of irradiated pupae was also inhibited. In flies which received a single dose, a linear relation was seen between mean life span and rate of imago formation which suggests that early effects play important roles in delayed effects. Mean life span of control females was longer than the males. With the fractionated doses, linearity was lost in the high dose range. Male mortality increased whereas in the female it was nearly constant from the 4th - 10th week, after which it rose rapidly with age. Before the 4th week, no significant difference in mortality was observed between sexes. The increase in mortality rate after the 4th week in males was caused by acceleration of aging. On the other hand, in the female, no acceleration of aging in this period was noted. When pupae were irradiated with a single dose of 960 R, high mortality was observed from the beginning of adult life. This arose from residual injury produced during pupal irradiation. The first part of the mortality curve paralleled the controls. Then it reached a shoulder at the 4th week, continued to hold the same value for weeks, and then sharply elevated hereafter. Slope of the last part of the curve simulated again that of the control. Radiation injury produced by a single dose of 960 R accumulated and accelerated aging as evidenced by shortening of the plateau. A linear relation was observed between mean life span and rate of imago formation, but a much higher dose was required to produce an identical effect in fractionated than in single irradiation. Thus, dose fractionation reduced early as well as late effects. As for rate of weekly mortality of irradiated male imagos, two fractions for a total dose of 1920 R was less effective than a single one of 1860 R. After single irradiation of 1860 R, adult mortality was high from the beginning of life and reached 100% at the 7th week without plateau. On the other hand, dose fractionation yielded lower initial mortality. Adults lived as long as 8 weeks and a plateau was not demonstrated. Thus radiation injury produced in pupae can be repaired but some of it is still operative in adult life and plays some role in killing adults. (NSA 20: 1966, 16291)

865 Strehler, B.L. STUDIES ON THE COMPARATIVE PHYSIOLOGY OF AGING. III. EFFECTS OF x-RADIATION DOSAGE ON AGE-SPECIFIC MORTALITY RATES OF Drosophila melanogaster AND Campanularia flexuosa.

Individually housed D. melanogaster were exposed to x-ray doses ranging from 1000 - 50 000 R and the subsequent mortality observed. 50 000 R causes a life shortening of approximately 1 d/2000 R as calculated from the age specific mortality rates 30-70 d after exposure. No detectable effect occurred up to 5000 R. The life span of C. flexuosa was strikingly increased by exposure to ionizing radiation; for example, 25 000 R actually doubled life span. These observations are in conflict with the somatic mutation hypothesis of aging, at least in these species. (Auth.)

866 Strickberger, M.W. EXPERIMENTAL CONTROL OVER THE EVOLUTION OF FITNESS IN LABORATORY POPULATIONS OF Drosophila pseudoobscura. Genetics 51 (1965) 795-800.

Four strains of D. pseudoobscura isogenic for the AR third chromosome arrangement were permitted to evolve for an 18-month period under different degrees of recombination in bottles and in population cages, and under two different degrees of mutation in the cages. The competitive ability of AR chromosomes from each of these sources was then tested under population cage conditions against strains carrying the CH arrangements. For both AR from bottle and cage origins, the degree of fitness evolved was enhanced by the extent of recombination that had been experienced. At the same time, the highest competitive frequencies achieved by AR chromosomes appeared to be limited by the amount of their initial genetic variability. The mutation effect produced by 8000 R of x-rays neither enhanced nor detracted from the evolution of fitness of the AR chromosomes to which it had been added. (Auth.)

867 Wood, V.G. THE EFFECTS OF x-RADIATION ON LONGEVITY IN Drosophila melanogaster. p. 21 of "Research and Development in Progress. Biology and Medicine. No. 3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

868 Wood, V.G. THE EFFECT OF x RADIATION ON LONGEVITY IN Drosophila melanogaster. Final Technical Report. TID-20550, Taylor Univ., Upland, Ind. Apr. 1964, 83p.

The length of life of control and irradiated populations of D. melanogaster was investigated over a 4-year period. Two unrelated wild type strains of flies were crossed and inbred stock from this mating was exposed to doses of x-radiation ranging from 25 to 60 000 R. Both mated and unmated groups were studied and radiation exposure was given during each developmental period. The data indicate that females outlive males in both irradiated and control groups, and unmated flies live longer than mated flies. A slight increase in life span was noted in flies exposed to the lowest doses of radiation. Possible explanations are discussed. (NSA 18: 1964, 19554)

See also:

593 Viability of heterozygotes for induced mutations in Drosophila melanogaster. I. Irradiated X-chromosome. (Falk, R. et al., 1965)

594 x-ray induced sex-linked lethal and detrimental mutations and their effect on the viability of Drosophila melanogaster. (Friedman, L.D., 1964)

649 Determination of the optimum sterilizing dosage for pink bollworm treated as pupae with gamma radiation. (Ouye, M.T. et al., 1964)

659 The potential application of γ-radiation for the sterilization of Chloridea obsoleta for the purpose of reducing its population. (Andreev, S.V. et al., 1964)

767 Gametogenesis and radiation effects in the cereal leaf beetle, Oulema melanopa. (Hoopingarner, R.A. et al., 1965)

785 The effects of high level x-irradiation on adult house fly flight ability and longevity. (Rockstein, M. et al., 1965)

812 Radiation sensitivity of immature stages of the giant milweed bug. (Crossley, D.A., Jr. et al., 1965)

816 Some effects of gamma irradiation on the gypsy moth, Porthetria dispar. (Godwin, P.A. et al., 1964)

818 Some observations on the effect of ionizing radiation against desert locust. (Huque, H., 1963)

819 Possibilities of controlling Callosobruchus subinnotatus Pic. (Huque, H., Khan, M.A., 1964)

820 Effects of ionizing radiation on eggs and adult insects. (Lippold, P.C., Gambrell, F.L., 1965)

823 Biological and histopathological effects of gamma radiation on three life stages of Anthonomus grandis Boheman. (Mayer, M.S., 1964)

829 The gamma irradiation of Glossina puparial stages and control. (Potts, W.H., 1965)

876 Mortality and life span of D. melanogaster (a wild-type and a mutant strain with a ring-X chromosome) exposed as young adults to x-rays or to high doses of cobalt-60 gamma-rays. (Sonnenblick, B.P., Rockford, D., 1964)

880
The influence of gamma rays on the longevity of Tribolium confusum Duval. (Vereecke, A.,
881 Pelerents, G., 1965)

886 Absence of "oxygen after-effects" in Calandra granaria during hibernation induced with low temperature. (Bychkovskaya, I.B., Ochinskaya, G.K., 1965)

891
892 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1964)

893 Prospects of integrated radiation and microbial control of harmful insects. (Jafri, R.H., 1965)

897 Action différentielle des rayons x et ultraviolets sur le tardigrade Macrobiotus areolatus à l'état actif et desséché. (May, R.M. et al., 1964)

903 Notes on the effect of preconditioning confused flour beetles with temperature variations or carbon dioxide prior to gamma irradiation. (Tilton, E.W. et al., 1965)

904 The effects of confining confused flour beetles in gelatin capsules before, during, and after gamma irradiation. (Tilton, E.W. et al., 1965)

912 Some supplementary data concerning the influence of γ rays on worker bees. (Pelerents, C., Brander, J. van den, 1963)

927
Long-term effects of acute low-level x-rays on the population dynamics of the yellow fever
928 mosquito, Aëdes aegypti. (Willard, W.K., 1965)

932 Progress report (on genetical studies), 1 October 1963 - 1 June 1964. (Dobzhansky, T., nd)

975 Cockchafer against cockchafer? An attempt at eradicating larvae of the field cockchafer Melolontha vulgaris Fabr. by means of x-rayed males. (Horber, E., 1963)

991 Summary of the mediterranean fruit fly investigation program June 1964 through May 1965. (Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador), 1965)

II/1270 The effect of radiation on the cockchafer, Melolontha vulgaris. (Lavrov, M.T., Bogomaz, V.A., 1958)

7. Lethal Effects

869 Banham, E.J., Crook, L.J. SUSCEPTIBILITY OF THE CONFUSED FLOUR BEETLE, Tribolium confusum Duv., AND THE RUST-RED FLOUR BEETLE, Tribolium castaneum (Herbst), TO GAMMA RADIATION. p. 107-118 of "The Entomology of Radiation Disinfestation of Grain", Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966*, 236p.

The study was carried out to compare the susceptibilities of the developmental stages of the two species, and to establish the efficacy of 16 000 rad for their control. All developmental stages of T. castaneum are more resistant to γ-radiation than T. confusum. Eggs, larvae, pupae, and

adults of T. confusum require doses of 4400, 5200, 14 500, and 12 800 rad, respectively, for 99.9% kill; the corresponding doses for T. castaneum are 10 900, 10 500, 25 800, and 21 500 rad. Production of progeny by T. confusum is reduced by 99.9% at 3400, 6400, 4700, and 7100 rad, respectively. Doses of 8600, 8100, 6200, and 8600 rad are required to obtain this reduction in T. castaneum. Fertility of adults of both species may be recovered to some extent after irradiation with substerilizing doses; there is no redevelopment of fertility in insects receiving doses approaching the evaluated commercial dose of 16 000 rad. This dose controls both species although a small residual population (10%) of sterile T. castaneum may survive.

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* Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

870 Cornwell, P.B. SUSCEPTIBILITY OF LABORATORY AND WILD STRAINS OF THE GRAIN WEEVIL Sitophilus granarius (L.) TO GAMMA RADIATION. p. 19-26 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966*, 236p.

Whilst reduced variability in the gene constitution of laboratory strains makes them useful for preliminary studies on radiation susceptibility, wild strains must also be examined in evaluating radiation levels for commercial application. Tests on five laboratory strains and 30 wild strains of S. granarius (L.) from various parts of the world showed marked differences in susceptibility to killing by irradiation but only slight differences in response to sterilization. The dose level of 16 500 rep, previously evaluated for the sterilization of large populations of a laboratory strain, may therefore be recommended for the commercial disinfestation of naturally occurring populations. (Auth.)

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* Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

871 Jacklin, S.W., Smith, F.F., Boswell, A.L. EGG MORTALITY AFTER GAMMA IRRADIATION OF ADULTS OF THE OMNIVOROUS LEAF ROLLER. J. econ. Ent. 58, 6 (1965) 1168-9.

Pupae of Platynota stultana (Walsingham) were sexed, and subjected to γ-irradiation from a ^{60}Co-source within 24 h of eclosion. Dosages of 4, 8, and 16 kR were tested on females, and 8, 16, 24, and 32 kR on males. Individual matings were arranged within the next 24 h. Up to 38 pairings were tested. For both male-treated and female-treated pairings the percentage of pairing which produced viable eggs decreased as the dosage increased. The observed egg mortalities, adjusted by Abbott's formula, showed that treatments of 16 kR for females and 32 kR for males produced over 90% egg mortality.

872 Jefferies, D.J., Banham, E.J. THE EFFECT OF DOSE RATE ON THE RESPONSE OF Tribolium confusum Duv., Oryzaephilus surinamensis (L.) AND Sitophilus granarius (L.) TO ^{60}Co GAMMA RADIATION. p. 177-185 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966*, 236p.

The lethal response of three stored products pests, T. confusum, O. surinamensis and S. granarius, to γ-radiation is modified by variations in dose rate in the range 1500-4700 rad/h; the higher the dose rate the greater the mortality and the lower the LD50. A similar response to radiation intensity is obtained in the level of sterility of O. surinamensis; no change in the level of sterility of S. granarius occurs within the range investigated. Comparison of the results with previous observations on S. granarius, irradiated at much higher dose rates, suggests a possible parabolic relationship between dose rate and LD50 (or SD50), modifications at low radiation intensities being attributable to processes of recovery and at high radiation intensities to depletion of oxygen. An optimum intensity for commercial disinfestation of grain by irradiation is suggested. The effect of dose rate is particularly marked at low radiation intensities normally used in laboratory investigations; to avoid modification of dose/response curves, the use of constant dose rates is preferable to constant time exposure. (Auth. summary)

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* Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

873 Lee, W.R. PARTIAL BODY RADIATION OF QUEEN HONEYBEES. J. Apic. Res. 3, 2 (1964) 113-16.

Experiments were performed to develop methods of non-lethal irradiation of spermatheca or oogonia of a queen honey bee (Apis mellifera). Queens with abdominal segments III-V shielded survived otherwise lethal doses of radiation; irradiation of segments III-V, or whole-body irradiation, with 10 000 R killed all queens within 3 weeks. Protection of the regenerative cells of the ventriculus appeared necessary to prevent death of the queens. Lead shields for this purpose are described and illustrated. (BA 46: 1965, 82909)

874 Neharin, A., Calderon, M., Yacobi, O. SUSCEPTIBILITY OF Callosobruchus maculatus TO HIGH DOSE RATE GAMMA IRRADIATION. A Preliminary Study. IA-1010, Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth. Jan. 1965, 11p.

C. maculatus in various stages of development was irradiated at high dose rates with a ^{60}Co γ-source. High radiosensitivity was found, the most sensitive stage being the eggs, where 50% and 100% mortality were produced by 1000 and 3000 rad respectively. A mixed population of adults of both sexes was completely sterilized by a dose of 10 000 rad. Eggs were laid but they were not viable. The high radiosensitivity observed is attributed to the high dose rates used. (Auth.)

875(2) Rinehart, R.R., Valencia, R.M., Valencia, J.I. COMPARATIVE LETHAL RATES FROM X-IRRADIATED D. melanogaster MALES AND FEMALES MATED TOGETHER OR TO UNIRRADIATED PARTNERS. Drosoph. Inf. Serv. 38 (1963) 71-2.

876 Sonnenblick, B.P., Rockford, D. MORTALITY AND LIFE SPAN OF D. melanogaster (A WILD-TYPE AND A MUTANT STRAIN WITH A RING-X CHROMOSOME) EXPOSED AS YOUNG ADULTS TO x-RAYS OR TO HIGH DOSES OF COBALT-60 GAMMA-RAYS. Drosoph. Inf. Serv. 39 (1964) 113-4.

877(2) Szyszko, E., Wozniak, J., Malesa, J. EFFECTS OF IONIZING RADIATION ON PESTS IN CEREALS. II. EFFECTS OF COBALT-60 RADIATION ON Tyroglyphus farinae MITES. Roczn. pañst. Zakl. Hig. 13, 5 (1962) 493-501. (In Polish)

After finding a stimulating action of small doses (5×10^2 - 1.5×10^4 R) of x-ray radiation on the vitality of T. farinae, further studies on the effects of radiation from Co source on the same mites were carried out. The mites were put, together with feed, in vessels of special construction; after 3 - 5 d of acclimatization, one group of vessels was irradiated from a ^{60}Co source. Observations of irradiated and non-irradiated mites were extended to 30 - 40 d. Doses of $1.8 - 2 \times 10^4$ R were lethal to mites, $1.4 - 1.6 \times 10^4$ R inhibited reproductive ability, and 1.2×10^4 R destroyed eggs of the insects. Natural sources of radiation are much better than x-rays for practical application in mite control. (From CA 62: 1965, 13788g)

878 Ulrich, H., Würgler, F.E. GENETISCHE UND NICHTGENETISCHE STRAHLENEFFEKTE IN Drosophila-EIERN. (Genetic and non-genetic radiation effects on Drosophila eggs). Zool. Anz., Suppl. 27 (1964) 602-6. (In German)

The linear dose-effect curve obtained after 3 min exposures of 10-20-min-old eggs has been found to consist of various curves of different gradients and shapes which arise from nuclear division of the individual stages contained in eggs laid in a 10-min period. Embryonic mortality due to radiation must be broken down into at least early and late embryonic mortality. The straight-line dose-effect curve may therefore be broken down into non-linear curves in terms of the inhomogeneity of the irradiated egg batch laid over a period of 10 min and of the effects observed. The hypothesis according to which post-irradiation mortality of Drosophila eggs is due mainly to chromosome breaks and their effects must therefore be expanded to allow for other contributing radiation effects which are not of a chromosomal nature.

879 Upadhya, M.D., Brewbaker, J.L., Macion, E.A. EFFECT OF GAMMA IRRADIATION ON MANGO SEED WEEVIL (Sternochetus mangiferae) (Fabricius)). p. 39-46 of "Dosimetry, Tolerance, and Shelf Life Extension Related to Disinfestation of Fruit and Vegetables by Gamma Irradiation", Annual Report, June 1, 1964 - May 31, 1965. UH-235P5-1, Hawaii Univ., Honolulu, Coll. of Tropical Agriculture. Jun. 1965, 78p.

Studies were conducted to determine the dose of γ-radiation necessary to completely kill seed weevils in mango fruits and the effects of these doses on the fruit. Preliminary results on two mango varieties indicated that the effective killing dose for seed weevils was between 30 and 60 krad. Fruits of some varieties were damaged at above 60 krad. (NSA 20: 1966, 18298)

880 Vereecke, A., Pelerents, C. THE INFLUENCE OF GAMMA RAYS ON THE LONGEVITY OF Tribolium confusum Duval. For abstract, see 881. Presented at the "17th International Symposium on Crop Protection Rijkslandbouwhogeschool, Gent, Belgium, 4 May, 1965".*

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* Pesticide Prog. 4, 1 (1966) 19. Abstr.

881 Vereecke, A., Pelerents, C. DE INVLOED VAN GAMMASTRALEN OP DE LEVENSDUUR VAN Tribolium confusum Duval. (The influence of gamma rays on the longevity of Tribolium confusum Duval). Meded. LandbHoogesch. OpzoekStns Gent 30, 3 (1965) 1824-35. (In Flemish, with English, French, and German summaries)

The applied doses ranged from 1000 - 60 000 rad. The mean life span and the survival curve are mentioned. Three groups of doses can be distinguished in terms of mortality rate. A dose of 40 000 rad is sufficient for direct control by γ-irradiation.

See also:

16 The effect of tritiated thymidine and gamma irradiation on the mortality of adult Drosophila melanogaster. (Kent, E., 1965)

17
18 } The effect of tritiated thymidine and gamma irradiation on the mortality of Drosophila melanogaster larvae. (Kent, E., 1964)

641 Susceptibility of the saw-toothed grain beetle, Oryzaephilus surinamensis (L.), to gamma radiation. (Jefferies, D.J., 1966)

647 Lethal and sterilising effects of cobalt-60 gamma rays on Argyroploce leucotreta. (Myburgh, A.C., 1963)

653 Susceptibility of Australian strains of Sitophilus and Tribolium species to gamma radiation. (Shipp, E., 1966)

658 Induced sterility of adult Diatraea saccharalis (Fab.) by gamma irradiation. (Walker, D.W. et al., 1964)

783 The effects of x-rays on the meal worm, Tenebrio molitor, embryo. (Po-Chedley, D.S., 1965)

807 Effect of gamma rays on immature stages of the Mexican fruit fly. (Benschoter, C.A., Telich, J., 1964)

811 Susceptibility of the grain and rice weevils, Sitophilus granarius (L.) and Sitophilus zeamais Mots. to gamma radiation. (Cornwell, P.B., 1966)

838 Irradiation effects on spermatogenesis in the gypsy moth, Porthetria dispar (L.). (Rule, H.D. et al., 1965)

843 The effects of gamma radiation on the biology and behavior of forest insects and the possibility of their control. (Stark, R.W., Wood, D.L., 1964)

846 Irradiation studies with insects infesting bulk-grain and packaged commodities. (Tilton, E.W., Brower, J.H., 1965)

861 Effects of gamma rays on mortality, longevity and fecundity of some species of fruit flies. (Narayana, E.S. et al., 1963)

883 The effect of culture environment on the susceptibility of Sitophilus granarius (L.) to gamma radiation. (Bull, J.O., Cornwell, P.B., 1966)

884 Analysis of the dependence of the protective action of hypoxia on the radiation dose. (Bychovskaya, I.B., Ochinskaya, G.K., 1964)

885 Oxygen effect in x- and gamma-irradiation of grain weevils. (Bychkovskaya, I.B., Ochinskaya, G.K., 1964)

887 A comparison of the susceptibility of the grain weevil Sitophilus granarius (L.) to accelerated electrons and ^{60}Co gamma radiation. (Bull, J.O., Cornwell, P.B., 1966)

892 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1965)

899 The influence of temperature upon the radiation susceptibility of Sitophilus granarius (L.). (Pendlebury, J.B., 1966)

900 The effect of rearing medium on the susceptibility of Tribolium confusum Duv. and Sitophilus granarius (L.) to gamma radiation. (Shipp, E., 1966)

1001 Control of weevil populations (Sitophilus granarius (L.)) with sterilising and substerilising doses of gamma radiation. (Cornwell, P.B. et al., 1966)

1002 USDA research program and facilities for the use of gamma irradiation in the control of stored-product insects. (Laudani, H. et al., 1965)

1009 The possibility of using the ^{60}Co radioisotope against grain storage insects. (Blazek, H. et al., 1964)

1010 The entomology of radiation disinfestation of grain. (Cornwell, 1966)

1013 Radiation treatment of grain and grain products. (Henderson, L.P., 1964)

1014 Effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (L.). (Jefferies, D.J., 1966)

1015 Post-harvest sterilization of oranges against Queensland fruit fly. (Leggo, D. et al., 1964)

1018 Dosimetry, tolerance, and shelf life extension related to disinfestation of fruits and vegetables by gamma irradiation. (Ross, E., Brewbaker, J.L., 1965)

1019 Disinfestation of dried fruits. (Shchegoleva, G.I., 1963)

1031 The killing of silkworm pupae and the preservation of silkworm cocoons by gamma rays. (Kipiani, R.Ya., Tsetskhladze, T.V., 1957)

1032 (Molnar, I. et al., 1962)

1033 A study of silk cocoons from the eggs of Bombyx mori L. irradiated with Co^{60}. (Molnar, I. et al., 1964)

1035 Differential effect of gamma radiation on fruit flies and fruit fly parasites. (Balock, J.W., 1965)

8. Modifying Factors

(Intensity. RBE. LET. Temperature. Synergists. Chemicals including Protective Agents. Environment at Irradiation. Medium. Pathogens. Etc.)

882 Baxter, R.C. RADIOBIOLOGIC STUDIES WITH Drosophila. p.25 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

883 Bull, J.O., Cornwell, P.B. THE EFFECT OF CULTURE ENVIRONMENT ON THE SUSCEPTIBILITY OF Sitophilus granarius (L.) TO GAMMA RADIATION.* p.57-69 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966,** 236p.

An examination is made of the effects of eight culture densities and two post-irradiation treatments on the susceptibility of adult grain weevils to γ-radiation from ^{60}Co. The lethal effect of γ-radiation is increased by culture densities which cause a substantial rise in metabolic temperature above 26°C during larval development. Densely crowded cultures in which temperatures during growth and maturation of larvae do not rise appreciably above 26°C fail to modify the adult's lethal response. Temperature fluctuations up to 36°C during development do not modify the susceptibility of the adult to radiation sterilization. Accordingly, the efficacy of 16 000 rad evaluated for the control of grain weevils is unlikely to be reduced by population densities normally encountered in commercial storage. (Auth.)

884 Bychkovskaya, I.B., Ochinskaya, G.K. ANALYSIS OF THE DEPENDENCE OF THE PROTECTIVE ACTION OF HYPOXIA ON THE RADIATION DOSE. Radiobiologiya 4, 2 (1964) 203-9. (In Russian). English Translation: AEC-tr-6405. Radiobiology 4, 2 (1964) 29-37.

Grain weevils (Calandra granaria) were x-irradiated in a 2% O atmosphere (controls in the usual, 20%, O concentration) at 500 R/min with doses of 1 - 150 kR. Survival data, presented in tabular form, indicated that under ordinary O conditions, doses of 1 - 3.5 kR are not lethal at 50 d. Lethality increased with dose, to 100% at 8 kR. Length of life was dose-dependent up to 35 kR, averaging 20 d with 5 - 35 kR, decreasing to 14 d at 40 - 70 kR, and to about 10 d at 75 - 150 kR. Under hypoxia conditions, 100% lethality at 50 d did not occur until the dose reached 13 kR; lifetimes averaged 20 d with from 9- to 50-kR doses, about 13 d with 55- to 80-kR, and about 10 d with 85- to 150-kR. The effects of hypoxia in decreasing the irradiation damage are presented as the ratio of doses, with an 8 kR dose under hypoxia conditions corresponding to 3.5 kR under ordinary conditions, or a ratio of 2.28. The ratio gradually decreased to 1.14 (85/75) at the higher levels. (NSA 18: 1964, 31296)

885 Bychkovskaya, I.B., Ochinskaya, G.K. OXYGEN EFFECT IN x- AND GAMMA-IRRADIATION OF GRAIN WEEVILS. Radiobiologiya 4 (1964) 928-9. (In Russian)

x- and γ-irradiation of grain weevils (Calandra granaria) in the presence of a normal amount of O_2 resulted in almost the same mortality. In the absence of O_2, mortality was lower for both, the decrease being greater for γ-irradiation.

886 Bychkovskaya, I.B., Ochinskaya, G.K. ABSENCE OF "OXYGEN AFTER-EFFECTS" IN Calandra granaria DURING HIBERNATION INDUCED WITH LOW TEMPERATURE. Radiobiologiya 5 (1965) 700-2. (In Russian)

The insects (C. granaria) were irradiated in special vacuum tubes at x-ray doses of 5, 6, 7, 8, 9, and 10 kR at a temperature of 1 - 5°C. The insects were held at a lowered temperature after irradiation for periods varying from 30 min - 12 d. The O_2 concentration was varied from 20 - 2% during and after irradiation. The survival at 60 d and the average lifetime of the irradiated insects were taken as criteria of radiation damage. On maintaining conditions of hypoxia during and after irradiation, a definite protective effect was observed. On creating conditions of hypoxia from the moment that the weevils had been warmed up to room temperature, no protective effect could be observed. Thus, no oxygen after-effect could be detected by maintaining the weevils at low temperatures. (NSA 20: 1966, 5385)

887 Bull, J.O., Cornwell, P.B. A COMPARISON OF THE SUSCEPTIBILITY OF THE GRAIN WEEVIL Sitophilus granarius (L.) TO ACCELERATED ELECTRONS AND ^{60}Co GAMMA RADIATION.* p.157-75 of "Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966, ** 236p.

No difference could be detected in the numbers of emerged adults, rate of emergence or stage at death in the grain when two types of infested wheat, containing mostly pupae, were treated with γ-radiation and accelerated electrons. Electron irradiation was carried out with a 4 MeV linear accelerator, giving 4 rad/pulse each lasting 2.5 μs and separated by 1660 μs. The difference in dose for 99.9% mortality and sterility with the two radiations was ~5000 rad. Mature adults were more susceptible to killing and sterilization by γ-irradiation. Possible explanations of the observed results are discussed. There is little likelihood of grain weevils providing a useful biological dosimeter in engineering studies for radiation disinfestation of grain. Adults provide more accurate estimates than pupae.

888 Erdman, H.E. MODIFICATIONS OF PRODUCTIVITY IN FLOUR BEETLES, Tribolium castaneum Herbst, DUE TO x-RAY DOSE, HYPOTHERMIA AND THE SEX EXPOSED. Radiat. Res. 25 (1965) 341-51.

Day-old virgin flour beetles, T. castaneum, were x-irradiated with 0, 500, 1000, 2000, or 4000 R. Ten replicates each of control, male-exposed, female-exposed, and both-exposed mating combinations were established at 25°C, 29°C, and 32°C in 65 to 70% relative humidity. Daily for 2 weeks each pair was given 5 g of acclimated food. The day of reproductive onset, the number of fertile pairs, and the number of F_1 adults were used as measures of productivity. Data are summarized and the modifications of the three parameters investigated for productivity are discussed from the standpoints of temperature effects and dose effects on the degree of development and differentiation of male and female germ cells. The dose-response curves were the multihit type, implicating chromosomal aberrations as the cause of altered productivity. (Auth.)

889(2) Giavelli, S., Parazzi, E. EFFECT OF LOW TEMPERATURE ON RADIOSENSITIVITY OF Drosophila PUPAE. Int. J. Radiat. Biol. 7, 5 (1963) 465-71.

To study the differential radiosensitivity of male germ cells and whether this is due to different metabolic conditions of the flies, 24- and 48-h-old pupae of D. melanogaster were irradiated with

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* For an earlier report, AERE-R-3893, see II/1080.

** Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

220 kV x-rays with a dose of 600 R at 0° and 25°C. Soon after emergence each male was mated to three M-5 virgin females, then transferred into a new vial with three virgin females every day for 10 d, to permit study of the radiation damage induced in germ cells irradiated at different periods of gametogenesis. The number of progeny of these matings and the recessive sex-linked lethal mutations were scored. A lower number of progeny was found in the broods of the experiments at 0 than at 25°C. No difference was observed in the mutation frequency induced by the treatments of 24- and 48-h-old pupae. With low temperature no difference appeared in the sensitivity pattern of pupae of different age. No evidence was found that different physiological conditions of pupae at different age may determine a different radiosensitivity. The effect of low-temperature treatment is discussed. (Auth.)

890(2) Jafri, R. H. SYNERGISTIC ACTION OF RADIATION AND OF Bacillus thuringiensis TOXIN ON PROTOZOAN DISEASES OF INSECTS. Int. Congr. Protozool. (1963) 510-15. (1st International Congress on Protozoology).

891 Jafri, R. H. INFLUENCE OF PATHOGENS ON THE LIFE SPAN OF IRRADIATED INSECTS. Revue Path. vég. Ent. agric. Fr. 43, 1 (1964) 37-41.

Experiments are reported on the effects of irradiation with x-rays, alone or in conjunction with infection with pathogenic Protozoa or bacteria, on the adults of Tribolium castaneum (Hbst.) and T. confusum Duv. and on the larvae of Galleria mellonella (L.). In the first series of tests, Galleria larvae were exposed to radiation doses of 1000 or 90 000 R. After the lower dose, slow dehydration took place; after the higher one, the larvae writhed as if burnt and, in spite of apparent recovery later, died within a few days, mid-gut microflora being found loose in the body cavity after death. In the second series, males and females of T. castaneum, some infected with Farinocystis tribolii, were exposed to doses of 1000 - 90 000 R. The subsequent life spans of the treated beetles were 10-40 and 1-45 d for infected males and females, respectively, and 15-115 and 1-115 d for uninfected ones and varied approximately according to the dose received except that, in the case of non-infected adults, doses of 30 000 and 50 000 R gave almost identical results. In the third series, healthy adults of T. confusum were irradiated in the same way and were then transferred immediately or after 24 or 144 h to flour contaminated with spores of Bacillus thuringiensis. Susceptibility to the bacterium was increased by irradiation at all doses, especially in beetles given non-lethal doses up to 10 000 R and fed 144 h later. The combination of F. tribolii and x-rays resulted in a more rapid mortality than did irradiation alone, since both caused consumption of the fat-body reserves. x-rays and B. thuringiensis both tended to break down the wall of the mid-gut, releasing the normal mid-gut bacteria into the body cavity. The usefulness of combined treatments for the control of stored-product pests not easily accessible to predators is discussed. (RAE-A 53; 1965, 8)

892 Jafri, R. H. INFLUENCE OF PATHOGENS ON THE LIFE SPAN OF IRRADIATED INSECTS. J. invertebrate Path. 7 (1965) 66-70.

Survival of flour beetles after exposure to x-radiation and infection with some of their natural pathogenic bacteria was investigated. The beetles infected by Adelina tribolii were more susceptible to Bacillus thuringiensis infection than were uninfected beetles. T. castaneum adults infected with Farinocystis tribolii were more radiosensitive to 1000, 10 000, 30 000, 50 000, and 90 000 R doses of x-rays than non-infected ones. The beetles receiving B. thuringiensis and having F. tribolii infection were much more damaged by sublethal and lethal doses of ionizing radiation. When T. confusum beetles received B. thuringiensis following exposure to sublethal and lethal doses of x-rays their life span was shortened to a week or at the most to two weeks. Neither sex showed any significant increased or decreased susceptibility when they received B. thuringiensis immediately and after an interval of 24 and 144 h following exposure to sublethal and lethal doses of x-rays. Ionizing radiation appears to act in the same way as B. thuringiensis, disintegrating the gut tissues and enabling the transgression of midgut bacteria into the body cavity of the host. (NSA 19: 1965, 45908)

893 Jafri, R. H. PROSPECTS OF INTEGRATED RADIATION AND MICROBIAL CONTROL OF HARMFUL INSECTS. p. 747-48 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul. 1964". Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

In nature some insects appear to be so abundant that the use of sterile male technique may not be feasible without first processing the geographically isolated and non-isolated infested area with other control measures to bring wild population within reach. Such a situation can be tackled from two angles. Firstly, the population may be controlled by means of well tried viruses, bacteria and suitable protozoan such as Microsporidian and Coccidian parasites. Secondly, the release of sterile male insects carrying parasites or pathogens, in order to contaminate the environment and destroy the progeny, has the potential future. A new approach in the form of susceptibility of irradiated insects to pathogens is opening a new field of investigation. The life span of Tribolium castaneum and T. confusum beetles was shortened considerably when the test insects received Bacillus thuringiensis immediately and after an interval of 24 and 144 h following exposure to 1000 R, 10 000 R, 30 000 R, 50 000 R and 90 000 R doses of x-rays, respectively. The life span of the irradiated beetles was somewhat shortened by the presence of Farinocystis tribolii, Nosema whitei and Adelina tribolii protozoan parasites in the fat-body of the test insects.* (From abstr.)

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* see Ref. 892

894 Krebs, A. T., Benson, B. W. ELECTRON SPIN RESONANCES IN Formicidae. Nature, Lond. 207 (1965) 1412-13.

Investigations on the effects of ionizing radiation on survival and behaviour of ants were extended into the field of microwave spectroscopy. The electron spin resonance spectra were recorded for 6 species of ants Lasius umbratus (Nyl.), Tetramorium caespiturn (L.), Formica exsectoides Forel, Formica fusca L., Camponotus castaneus (Latr.), and Pogonomyrmex occidentalis (Cress). One species was examined for changes in the signal after exposure to γ-radiation and another for changes after annealing. Irradiation caused an increase in height of the signal, followed by a slow decay with time after irradiation. Annealing, however, completely depressed the 6-peak signal and enhanced the free radical region signal.

895 Levengood, W. C. FACTORS INFLUENCING BIOMAGNETIC ENVIRONMENTS DURING THE SOLAR CYCLE. Nature, Lond. 205 (1965) 465-70.

The results are presented of a study of the variation of the reproductive response of Drosophila melanogaster, when grown in magnetic fields, with solar activity. The flies were grown in culture bottles placed on the opposite poles of permanent magnets. The effects of cosmic radiation, solar flare activity, barometric pressure, and the outer Van Allen Radiation Belt on progeny yields were studied. Possible mechanisms for the observed trends are considered. (NS 19: 1965, 15136)

896 Masera, E. TRATTAMENTO CON I RAGGI X DELLE UOVA DI Bombyx mori L. PARASITATE DA Nosema bombycis Naeg. (The treatment with x-rays of eggs of Bombyx mori L. parasitized by Nosema bombycis Naeg). Agricoltura Venezie 19, 2 (1965) 55-66. (In Italian)

897 May, R. M., Maria, M., Guimard, J. ACTION DIFFERENTIELLE DES RAYONS X ET ULTRA-VIOLETS SUR LE TARDIGRADE Macrobiotus areolatus A L'ETAT ACTIF ET DESSECHE. Bull. biol. Fr. Belg. 98, 2 (1964) 349-67.

Les auteurs ont isolé de nombreux individus de Tardigrades de l'espèce Macrobiotus areolatus vivant dans les Mousses et ils ont mis des lots en état de dessiccation artificielle, d'autres lots étant maintenus vivants. Les Macrobiotes desséchés, en état de vie latente, sont résistants aux rayons X avec 300 000 R, puisque le pourcentage de reviviscents est le même que celui des témoins non irradiés. La dose létale 50% est de 570 000 R un jour après l'irradiation, et une dose de 1 200 000 R inhibe complètement la reviviscence de tous les Macrobiotes exposés. Les animaux qui ne peuvent passer à l'état de vie active entrent dans l'état asphyxique. Lors des expériences d'élevage, le temps de survie des animaux desséchés irradiés à des doses de 300 000 R, 400 000 R, 600 000 R et 700 000 R puis reviviscents, est fortment raccourci par rapport à celui des animaux témoins; les animaux irradiés à des doses de 800 000 R, 900 000 R et 1 000 000 R à l'état desséché succombent au 5e jour. Les Macrobiotes en état de vie active sont tout d'abord aussi résistants à des doses de 200 000 R que des témoins non irradiés. La dose létale 50% est de 540 000 R (2 h après l'irradiation). Une dose de 1 200 000 R tue tous les Macrobiotes dans ce même temps. Les animaux morts présentent l'aspect asphyxique ici aussi. Lors des expériences d'élevage, le temps de survie des Macrobiotes actifs irradiés à des doses de 200 000 R est raccourci par rapport à la survie des témoins; les animaux irradiés à 900 000 R ne survivent pas au-delà du 4e jour, ceux irradiés à 800 000 R succombent le 8e jour, et ceux irradiés à 600 000 R succombent le 26e jour. Les animaux mis en état de vie latente, après un irradiation, ne peuvent revivre à partir d'une dose de 300 000 R.

898(2) Murakami, A., Kondo, S. RELATIVE BIOLOGICAL EFFECTIVENESS OF 14.1 MeV FAST NEUTRONS IN KILLING DORMANT SILKWORM EGGS. Rep. natn. Inst. Genet., Misima 14 (1963) 106-7.

Although the lethal effects of low ion density radiations, such as x- or γ-rays, upon silkworm eggs have been studied by many investigators, little is known about the effects of high ion density radiations. A study of RBE in mutation induction by high energy neutrons in dormant silkworm eggs was made. In these experiments the biological effectiveness of 14.1-MeV neutrons was compared with that of γ-radiation as concerns their killing effects on silkworm eggs in dormancy. The exposure to 14.1-MeV neutrons was conducted with the Cockcroft-Walton accelerator. Dormant silkworm eggs were exposed to neutron beams at a distance of 6.3 cm from the tritium target for a variable length of time, from 60 - 180 min. The neutron dose-rate was 5 rad/min and the total doses given were 500, 1000, and 1500 rad. In parallel to this, ^{137}Cs γ-ray treatment was carried out on the same material. The γ-ray doses were 500, 1000, 3000, and 5000 R at a dose rate of 100 R/min. The percentages of hatchability were plotted against doses given on semilogarithmic scale both for fast neutrons and γ-rays. The hatchability curve after exposure to 14.1-MeV neutrons declined more rapidly than that for ^{137}Cs γ-rays. The calculated doses that allow 50% hatchability LD50 were 600 rad and 2000 rad for 14.1-MeV neutrons and ^{137}Cs γ-rays, respectively. Thus 14.1-MeV neutrons are more effective than ^{137}Cs γ-radiation with regard to their killing action. The RBE thus calculated was 3.3. (NSA 20: 1966, 72)

899 Pendlebury, J.B. THE INFLUENCE OF TEMPERATURE UPON THE RADIATION SUSCEPTIBILITY OF Sitophilus granarius (L.).* p. 27-40 of "Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966, ** 236p.

Previous studies on the susceptibility of adult grain weevils to γ-radiation have been carried out at an optimal temperature for the species. The experiment described examines the lethal and sterilizing response of adult S. granarius to high and low temperatures, (30° and 15°C) before, during and after irradiation. These are near the limiting temperatures for oviposition and close to the extremes likely to be encountered in commercial practice. Rate of death was considerably increased by high temperature after irradiation. High temperature before irradiation resulted in a slight increase in lethality at doses between 3000 and 10 000 rad when compared with similar batches held at the lower temperature. During irradiation, the influence of temperature was reversed and insects irradiated at 15°C subsequently showed a greater mortality than those irradiated at 30°C. Susceptibility to radiation sterilization was unchanged. The minimum dose of 16 000 rad evaluated for control of grain weevils would thus be effective at all temperatures likely to be encountered in commercial practice. (Auth.)

900 Shipp, E. THE EFFECT OF REARING MEDIUM ON THE SUSCEPTIBILITY OF Tribolium confusum Duv. AND Sitophilus granarius (L.) TO GAMMA RADIATION. p. 97-105 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966,* 236p.

Rate of development of T. confusum Duv. and the yield of adults on different milling fractions is influenced by the chemical composition of the cereal medium. Rapidly developing flour beetles are more susceptible to killing by γ-radiation when measured at 21 d; the period before latent radiation damage culminated in death is also shortened. Susceptibility at 28 d is not modified by rearing medium. Rate of development of S. granarius (L.) on different whole cereals and the yield of adults appear not to be directly correlated with chemical composition; they are more probably influenced by physical factors such as grain size. Weevils reared on different grains show differences in susceptibility to γ-radiation at the LD50 which cannot be correlated with any of the experimental indices considered. (Auth.)

901 Slater, J.V., Yu, M.E., Tobias, C.A. OXYGEN DEPENDENCE FOR RADIATION SENSITIVITY DURING DEVELOPMENT IN INSECTS. Radiat. Res. 22, 1 (1964) 236. Abstr. 189.

As with most biological materials, the absence of oxygen during irradiation has been found to result in a considerable protective effect in developing Tribolium where the percentage of wing abnormalities is reduced. Nearly 3 times as much x-irradiation is required to produce the same effect in the absence of oxygen as when this gas is present. These studies were all done at 30°C. Studies on the effect of oxygen concentration have shown that 5% O_2 mixed with 95% N_2 results in half-maximal damage at 1500 R. When pupae are placed in 1.3 atm of pure O_2 for only a few seconds, the adults upon eclosion exhibit the same kinds of wing abnormalities which appear after x-irradiation in this organism except that missing antennae and limbs and burnt-off appearing limb stumps also result. Although radiation damage can be observed in Tribolium after exposure of the pupae to 1000 and 1200 R in air, post-irradiation exposure to N_2 at these dose levels appears to have no effect. At 1500 R, however, radiation damage is increased by nearly 20% when N_2 is passed through the exposure chamber containing pupae in the sensitive phase immediately after irradiation. (Abstr.)

902 Slater, J.V., Lyman, J., Tobias, C.A., Amer, N.M., Beck, J.S., Beck, M., Slater, A.J. HEAVY ION LOCALIZATION OF SENSITIVE EMBRYONIC SITES IN Tribolium. Radiat. Res. 21 (1964) 541-9.

The Berkeley heavy ion linear accelerator was used in probing for the embryonic sensitive sites responsible for wing morphogenesis and differentiation in Tribolium confusum Duv. The α-beam was used because of the necessary range desired in most instances. In some experiments, neon ions were used, however, to evaluate the dose effect at significant depths which were quite shallow (~ 200 μm). Neon was especially useful for determining the comparative intensities of these sites because of the sharp Bragg peak exhibiting little or no straggling. The existence of two shallow and equivalent sensitive sites for wing differentiation and development were indicated. The developmental interval during which radiation must be applied to give the bulk of malformation incidence is restricted to a very short time interval. A hypothesis has been advanced that the primary intracellular effect of radiation in the embryo is the induction of somatic chromosome aberrations resulting in cell lethal action prior to or during mitosis.

903 Tilton, E.W., Burkholder, W.E., Cogburn, R.R. NOTES ON THE EFFECT OF PRECONDITIONING CONFUSED FLOUR BEETLES WITH TEMPERATURE VARIATIONS OR CARBON DIOXIDE PRIOR TO GAMMA IRRADIATION. J. econ. Ent. 58, 1 (1965) 179-80.

The effects of temperature and CO_2 on the susceptibility of Tribolium confusum Duv. to γ-radiation were investigated in the laboratory. Pupae were isolated individually in gelatin capsules with sufficient food to sustain the adult for a week. When the adults were 7 to 9 d old, some were kept at 50-55 or 104°F for 24 h or anaesthetized with CO_2 for 30 min and treated 1 h later with a dose of 17 500 rad of γ-radiation from a ^{60}Co-source; others were irradiated without special conditioning. They were then kept at 80°F and 50% relative humidity for 42 d. None of the preconditioning treatments had any significant effect on the mortality of the beetles, all of which were dead or moribund in 14 d and dead in 28 d. (RAE-A 53: 1965, 247)

904 Tilton, E.W., Burkholder, W.E., Cogburn, R.R. THE EFFECTS OF CONFINING CONFUSED FLOUR BEETLES IN GELATIN CAPSULES BEFORE, DURING, AND AFTER GAMMA IRRADIATION. J. econ. Ent. 58, 1 (1965) 175-6.

In preliminary experiments with γ-irradiated and untreated larvae, pupae and adults of Tribolium confusum Duv. that were reared individually in gelatin capsules on a medium consisting of equal parts of wheat flour and rice bran with 0.5% yeast at 80°F and 50% relative humidity, there were no significant differences in mortality or rate of development between those kept in sealed and those kept in open capsules. (RAE-A 53:1965,246)

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* For an earlier report, AERE-R-3641, see II/1103.

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See also:

16 The effect of tritiated thymidine and gamma irradiation on the mortality of adult Drosophila melanogaster. (Kent, E., 1965)

17 The effect of tritiated thymidine and gamma irradiation on the mortality of Drosophila
18 melanogaster larvae. (Kent, E., 1964)

797 Survival of isolated embryonic heart fragments following treatment with some radiation protecting chemicals. (Larsen, W., 1964)
798 The effects of x irradiation on the embryos of invertebrate embryos. (Larsen, W., 1965)
799 Influence of radiation on ovarian maturation and histolysis of pupal fat body in Diptera. (Monro, J., Bailey, P.T., 1965)
802 Analysis, by means of x- and u.v.-irradiation, of the course of differentiation in the insect egg (Gryllus). (Seidel, F., 1964)
806 Dose fractionation and recovery from x rays in Rhodnius. (Baldwin, W.F., Shaver, E.L., 1964)
814 Differential responses of germ cells in flour beetles, Tribolium castaneum Herbst, due to x-ray dose, hypothermia, sex exposed and age. (Erdmann, H.E., 1964)
815 x-ray and gamma ray irradiation of Mormoniella vitripennis. (Farrow, M.G., Ulrich, V., 1964)
860 Effect of beta irradiation on insects. (Menhinick, E.F., Dodson, G.J., 1965)
863 Radiation induced shortening of life of Sarcophaga peregrina and its modification by dose fractionation. (Sakka, M., 1965)
864 x-ray induced shortening of life span of adult Sarcophaga peregrina and its modification by dose fractionation. (Sakka, M., 1965)
872 The effect of dose rate on the response of Tribolium confusum Duv., Oryzaephilus surinamensis (L.) and Sitophilus granarius (L.) to ^{60}Co gamma radiation. (Jefferies, D.J., Banham, E.J., 1966)
873 Partial body radiation of queen honeybees. (Lee, W.R., 1964)
918 The establishment of Tribolium confusum Duv. populations after stress by parasitism and x-irradiation. (Dowell, F.H., 1964)
1014 Effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (L.). (Jefferies, D.J., 1966)

C. RADIATION EFFECTS ON INSECT POPULATIONS

1. Behaviour

905 Baumhover, A.H. SEXUAL AGRESSIVENESS OF MALE SCREW-WORM FLIES MEASURED BY EFFECT ON FEMALE MORTALITY. J. econ. Ent. 58, 3 (1965) 544-8.

Harassing by males of Callitroga (Cochliomyia) hominivorax (Coquerel) accelerated the death of the females. The sexual activity of the males was measured by a sexual aggressiveness (SAG) test, based on the mortality of females exposed to a high ratio of males, a 1:3 ratio being arbitrarily selected as the standard. The fallacy of using data on male survival as an index of sexual vigour was demonstrated in SAG tests in which, although some sexually inactive males lived as long as active ones, their vigour was less. The SAG test showed that the sexual activity of males resulting from pupae that had been exposed when 5-d-old to doses of γ-radiation from ^{60}Co of 3000 - 12000 R decreased as the dose increased, the percentage mortality at 13 d of the females exposed to these males decreasing from about 80 to about 33; the length of life of the males was only slightly reduced, even at the highest radiation dose. The activity of males irradiated as pupae 6- to 7-d-old was affected only slightly at the highest dose. Males of a strain from Florida (Fla) and of a mutant strain with yellow eyes (y) reduced the survival of y females, but that of Fla females was not reduced by exposure to y males. Males from both strains fertilized about twice as many y as Fla females when females of both strains were present in excess (40:1). These studies indicated some of the factors that may influence SAG tests, and their bearing on the choice of a strain for use in attempts at field control by the release of irradiated males is discussed.

906 Brower, J.H. BEHAVIORAL CHANGES IN AN ANT COLONY EXPOSED TO CHRONIC GAMMA IRRADIATION. Bull. ent. Soc. Am. 11, 3 (1965) 158. Abstr. 82. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov.-2 Dec.1965".

Changes in behaviour of a colony of Formica integra were investigated in an area experimentally exposed to chronic γ-radiation. The habits of the colony changed so that ants were no longer exposed to high radiation levels. Possible explanations are presented. (Abstr.)

907 Dame, D.A., Woodard, D.B., Ford, H.R., Weidhaas, D.E. FIELD BEHAVIOR OF SEXUALLY STERILE Anopheles quadrimaculatus MALES. Mosquito News 24 (1964) 6-14.

Males of Anopheles quadrimaculatus were sexually sterilized by three methods. In the first method, they were contact-sterilized by exposure to thio-TEPA. In the second method, males were sterilized by feeding for the first 3 - 4 d after emergence on 1% apholate in 20% honey solution. In the third method, males were radiosterilized. Pupae from 0 - 24 h old were exposed to 12000 R of γ-radiation from a ^{60}Co source (660 R/min). After each treatment the insects were held under standard lab conditions prior to release as 1- to 4-d-old males. Through the concurrent release of sterile males and virgin females it was shown that sterilized males of the colonized strain A. quadrimaculatus were sexually vigorous and compatible with females in nature. Thus the sterile colony males were able to induce a high degree of sterility in colony females in the field, demonstrating that mating activity of these males was not seriously affected by either radiosterilization or chemosterilization. Although the sexual vigour of the colony male may be reduced by radiation, the results showed that when sufficient numbers of either radiosterilized or chemosterilized colony males were present in a population of their own kind, they could effectively reduce the fertility of the female. Although lab-reared wild males increased the natural sterility by 480, the inability of the colony males to induce sterility in the wild females of the natural population indicated that severe behavioural deficiencies existed in these males. These deficiencies were brought on ostensibly by the colonization process. It is speculated that other species which prove particularly difficult to colonize because of flight or mating behaviour may not be suitable for the sterile-male release approach to control. (NSA 19:1965, 24315)

908 Hungate, F.P. RADIATION AVOIDANCE RESPONSES IN ANIMALS. p.9 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

909 Kapil, R. LES EFFETS DES DOSES NON-LETALES DE RAYONS X SUR LE COMPORTEMENT EXPLORATEUR ET ALIMENTAIRE DE LA LARVE DE Drosophila melanogaster Meig. NP-15559, Lyon Univ. (France). Faculté des Sciences. 1964, 48p. Thèse.

Les données sur le mouvement de la tête avec le mouvement vertical synchronisé des mandibules des larves de D. melanogaster expliquent que cette fonction liée à la prise de nourriture peut être mesurée. La fonction évolue de façon comparable pendant la période larvaire pour les deux races - sauvage et vestigial - de D. melanogaster. La fonction dépend de l'âge et varie rapidement jusqu'à ce que les larves soient âgées de 12 h. Après 24 h, elle devient linéaire et les changements sont faibles jusqu'à ce que la larve se prépare à entrer en pupaison. Les expériences sur les effets des rayons x (p.23-33) montrent que la réponse des deux races est différent. L'inhibition maximum de la fonction est observée à 500 et 1500 R pour les larves de sauvage et vestigial respectivement. Pour les deux races, l'effet d'inhibition aux doses faibles est remplacé par un effet d'excitation aux doses plus fortes. La réponse de la fonction reste presque la même chez sauvage, que l'on irradie les larves âgées de 2 h ou les embryons de 10 h. Les auteurs n'ont pas trouvé d'effets retardés concernant le comportement étudié, avec les doses employées dans les présentes expériences. (Du resumé)

910 Kvelland, I. SOME OBSERVATIONS ON THE MATING ACTIVITY AND FERTILITY OF Drosophila melanogaster MALES. Hereditas 53, 3 (1965) 281-306.

Data are presented on mating and fertility patterns of 0- to 2-h-old males and of 3-d-old non-irradiated and irradiated males (given 2000 R x-rays at 145 R/min). The males showed a higher mating activity in the 1st h of a 12-h period than in any interval. The youngest males showed an increase in mating frequency from the 1st day of mating up to a male age of 7d, with subsequent decrease. The older males (first mating period in light) showed a sharp drop in mating frequency from the 1st-2nd day of mating, an increase to the 7th day, and thereafter a gradual decrease. The irradiated males showed a mating frequency of the first 3 d of mating similar to that found for the non-irradiated older males; on the following 7 d, however, the irradiated males showed a noticeably lower mating frequency than did the control males. Male productivity (in the young group) increased from the 1st - 3rd day of mating, but for the older males (in the older group) productivity decreased significantly from the 1st - 2nd day of mating. For both groups of males productivity decreased gradually after the 3rd day of mating. Individual males in all groups showed great variations in mating capacity, fertility, fecundity, and productivity.

911 Mason, H.C., Papageorgiou, M.C., Jacklin, S.W. MATING PREFERENCE AND REPRODUCTION OF IRRADIATED Drosophila melanogaster. Bull. ent. Soc. Am. 11, 3 (1965) 159. Abstr. 83. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec. 1965".

D. melanogaster males showed no mating preference between irradiated and normal females. Reproduction in populations was lowered more by introduction of irradiated males than irradiated females. When both irradiated males and females were introduced the suppression of reproduction was the same as when only irradiated males were used. (Abstr.)

912 Pelerents, C., Brande, J. van den SOME SUPPLEMENTARY DATA CONCERNING THE INFLUENCE OF γ RAYS ON WORKER BEES. Bull. Inst. agron. Stns Rech. Gembloux 31 (1963) 576-83. (In French)

The reactions of bees immediately after irradiation with doses of 40 000, 50 000, and 60 000 rad is to form swarms that separate only after 6 or 7 h. Higher doses produce an atony. The effects of γ-rays on the life span and on the consumption of candy were determined. Doses higher than 10 000 rad affect the construction of the combs. Doses below 15 000 rad do not affect the production of combs. (NSA 19:1965, 17528)

See also:

639 Gamma radiation and the reproductive behavior of male Rhodnius prolixus. (Gomez-Numez, J.C. et al., 1964)

829 The gamma irradiation of Glossina puparial stages and control. (Potts, W.H., 1965)

839 The effect of x rays on adult Hyalomma asiaticum. Communication I. (Sidorov, V.E., Grokhovskaya, I.M., 1964)

843 The effects of gamma radiation on the biology and behavior of forest insects and the possibility of their control. (Stark, R.W., Wood, D.L., 1964)

958 Ecological changes in the insect community of a pitch pine-oak forest subjected to chronic gamma irradiation. (Brower, J.H., 1965)

975 Cockchafer against cockchafer? An attempt at eradicating larvae of the field cockchafer Melolontha vulgaris Fabr. by means of x-rayed males. (Horber, E., 1963)

2. Population Dynamics

913 Bell, A.E. THE EFFECTS OF x-RADIATION ON PLATEAUED POPULATIONS OF Tribolium castaneum IN REGARDS TO REPRODUCTIVE FITNESS AND RESPONSE TO SELECTION. p.128-29 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

914 Bell, A.E. THE EFFECTS OF x-RADIATION OF PLATEAUED POPULATIONS OF Tribolium castaneum IN REGARDS TO REPRODUCTIVE FITNESS AND RESPONSE TO SELECTION. Final Report. COO-965-21, Purdue Univ., Lafayette, Ind. 29 May 1964, 8p.

Results are summarized from a series of studies on the effects of various levels of x-radiation on the response to selection in plateaued population of the flour beetle, T. castaneum. The response of the plateaued population was compared with that of unselected base populations exposed to the same levels of radiation and selection intensity as to reproductive fitness and inheritance of qualitative genes or chromosome aberrations. A list is included of publications resulting from this study. (NSA 18:1964, 27061)

915 Bileva, D.S. A STUDY OF GENETIC PROCESSES IN IRRADIATED POPULATIONS. I. NUMERICAL DYNAMICS OF IRRADIATED POPULATIONS. Dokl. Akad. Nauk SSSR 164 (1965) 191-4. (In Russian)

The genetic processes occurring in populations exposed to various x-radiation doses were analysed in order to derive a numerical criterion for estimating the radiation effects and to derive dose relationships. Fifty males and females of an inbred line of Drosophila melanogaster were exposed to 500, 1500, 3000, and 5000 R of x-radiation, keeping the temperature constant at 24 - 26°C and using identical feeding conditions for all groups. It was assumed that after a certain number of generations, a numerical equilibrium will be reached. The results showed that during the period from 1 - 17 d, the irradiated populations lag behind the control group; however, within 22 - 45 d, some of the irradiated populations overtook the control group and from 55-144 d a numerical steady state was reached. This was followed by a second period of differences and a second equilibrium during the period from the 369th - 418th day. The initial decrease of the population seems to be due to radiation-induced mutations that reduce the fertility and the viability of the flies; they are rapidly eliminated under intensive breeding conditions. (NSA 20:1966, 18324)

916 Brower, J.H. CHANGES IN THE INSECT POPULATIONS OF THE LOW SHRUB SYNUSIA IN A NATURAL FOREST COMMUNITY EXPOSED TO CHRONIC GAMMA RADIATION STRESS. M.S. Thesis. Massachusetts Univ., Amherst. Feb. 1964, 43p.

A pre-irradiation study in the summer of 1961 was followed in November by irradiation studies of a typical stand of pitch pine-oak on dry sandy soil. Abundance gradients were established by a reliable sweep sampling technique. The greatest changes in insect populations resulted from vegetational changes which tended to mask less striking direct effects. The fact that radiation did have some direct effect was indicated by several factors. Thus, although food for fungivorous forms such as Collembola and Psocoptera seemed to be plentiful in the entire area of low shrub death, their abundance near the source was less than further out where populations were actually greater than normal. Second, another and even more definite sign of direct radiation effect was the delay in peak abundance and thus probably maturation for Cicadellidae and Cercopidae near the source. The delay was as great as 2½ weeks for both groups. The peak abundance was the same date for all points beyond 50 m for each group. At the 50 m point where abundance of Clastoptera proteus (a cercopid) was greater than normal there was also a slight stimulatory effect on the date of peak abundance, since it occurred 3 d earlier than normal. A 9500 Ci ^{137}Cs unit was used.

917 Carson, H.L. POPULATION SIZE AND GENETIC LOAD IN IRRADIATED POPULATIONS OF Drosophila melanogaster. Genetics 49, 3 (1964) 521-8.

Two experimental populations of the sepia-spineless-rough stock of D. melanogaster each received 65 000 R of x-rays over a period of 2½ yr. Two control populations were handled in an identical manner but received no radiation. All four populations were discarded 1 yr after the cessation of irradiation of the experimentals. The method of handling permitted weekly measurements of population size of all populations, affording a measure of fitness of the populations. As expected, the size of the experimental populations declines under radiation. Population size is recovered rapidly when radiation is suspended. Although one of the experimental populations maintained an elevated fitness level at several times for a number of generations, these effects were reversed and at the end of the experiment, controls and experimentals did not differ from one another. Following the cessation of the irradiation, the genetic loads of the irradiated populations were found to be elevated relative to the controls. These increased loads, however, disappeared within a year. Newly induced mutations do not appear to provide an important source of genetic diversity whereby fitness can be improved in experimental population systems where natural selection is operating. (Auth.)

918 Dowell, F.H. THE ESTABLISHMENT OF Tribolium confusum Duv. POPULATIONS AFTER STRESS BY PARASITISM AND x-IRRADIATION. Diss. Abstr. 25, 5 (1964) 3170-1.

The hypothesis tested was that parasitism of T. confusum by the cysticercoids of Hymenolepis microstoma Duj. (1945) reduces reproductive potential to an extent directly proportional to the level of such parasitism, this reduction being additive to the reduction caused by x-irradiation. Eight groups of larvae were used, consisting of all combinations of parasitism, no parasitism, three levels of irradiation [3000, 5000 and 15 000 R, at 24°C], and no irradiation, with an original sample size of 30 larvae and three replicates. Larvae selected for smallness show the highest per cent infestation and the greatest degree of replication, yet the smallest number of cysticercoids per beetle. There is a difference between non-irradiated, non-parasitized and non-irradiated, parasitized populations in the ability to establish themselves (the latter having less ability), but apparently this difference disappears as the total size of the population increases with population age. Decreasing ratio of parasitized to non-parasitized beetles with the passage of time and the increase in size of the total population is a possible explanation of this relationship. There is no difference between irradiated, parasitized and irradiated, non-parasitized populations in ability to establish themselves, regardless, from the limited data available, of the total size of the population. A tendency of irradiation to kill heavily parasitized beetles more readily than non-parasitized or lightly parasitized beetles is the probable explanation of this phenomenon. The results may be explained in terms of the hypothesis that both parasitism and irradiation (as limited above) reduce reproductive potential, that these reductions are additive, and that the reduction caused by parasitism is directly proportional to the level of parasitism.

919 Erdman, H.E. FAST-NEUTRON EFFECTS ON PRODUCTIVITY OF YOUNG AND OLD FLOUR BEETLES, Tribolium castaneum Herbst, AND ALTERATIONS AT DIFFERENT TEMPERATURES AND AFTER EXPOSURE OF EITHER OR BOTH SEXES. Int. J. Radiat. Biol. 9, 4 (1965) 305-11.

Virgin day-old and 3-week-old T. castaneum were given approximately 830 and 970 rad, respectively, of 4.6 MeV fast neutrons. Ten replicates of mating combinations in which neither sex, one sex, or both sexes were exposed were cultured at 25°C, 29°C, and 32°C in 65 - 70% relative humidity. Productivity, measured as adult progeny per reproducing female per day, was scored for 14 d. Decreases in temperature progressively delayed reproductive onset. Further delay in reproductive onset occurred when young female beetles were irradiated, indicating a greater radiation sensitivity of immature oogonia. Productivity of young beetles reached a plateau during the 2nd week; that of old beetles after the 1st day. When either sex only was irradiated, productivities were not significantly different at a particular temperature, but they were lower than the values obtained without any exposure and higher than when both sexes of a pair had been exposed. (From auth.)

920 Erdman, H.E. FAST NEUTRON EFFECTS ON FLOUR BEETLES. p.147-9 of "Hanford Biology Research Annual Report for 1963". HW-80500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 15 Jan.1964.

Effects on productivity of temperature, fast neutron irradiation, and the sex irradiated were investigated for the flour beetle, Tribolium castaneum. Earlier onset of reproduction and greater productivity were associated with increasing temperatures from 25 - 32°C. Exposure to fast neutrons delayed the onset of reproduction in females, and reduced the numbers of F_1 adults following male or female exposures. (Auth.)

921 Erdman, H.E. FAST NEUTRON EFFECTS ON PRODUCTIVITY OF YOUNG AND OLD FLOUR BEETLES, Tribolium castaneum Herbst AND ALTERATIONS DUE TO TEMPERATURE AND SEX EXPOSED. HW-SA-3537, General Electric Co., Richland, Wash. Hanford Atomic Products Operation. 6 Oct.1964, 16p.

Virgin day-old and 3 week old flour beetles, T. castaneum, strain Brazil CI, were given approximately 830 and 970 rad, respectively, of fast neutrons of average energy 4.6 MeV. Ten replicates of the mating combinations control, male-exposed, female-exposed, and both-exposed were cultured at 25°C, 29°C and 32°C in 65 to 70% relative humidity. Productivity, measured as adult progeny per reproducing female per day, was scored for 14 d. Decreases in temperature progressively delayed reproductive onset. Additional delay in reproductive onset occurred when young female beetles were irradiated, indicating a greater radiation sensitivity at this stage of oogonial maturation. Thereafter, no other indication of a differential radiosensitivity of germ cells was noted. Productivity of young beetles plateaued during the second week; that of old beetles after the first day. Male- and female-exposed productivities were not significantly different within a temperature but were less than control and greater than both-exposed. Neutron irradiation effects appeared additive in that both-exposed mating combinations had the expected number of progeny compared to those in which one sex only was exposed. (Auth.)

922 Erdman, H.E. AGE, TEMPERATURE, COEXISTENCE, AND x-RADIATION EFFECTS ON FLOUR BEETLES' PRODUCTIVITY. p.144-6 of "Hanford Biology Research Annual Report for 1963". HW-80500, General Electric Co. Hanford Atomic Products Operation, Richland, Wash. 15 Jan.1964.

Age, temperature, coexistence, and x-radiation influenced reproductive performance of flour beetles. The performance of Tribolium castaneum was superior to that of T. confusum. (Auth.)

923 Erdman, H.E. REPRODUCTIVE PERFORMANCE OF x-RAYED SINGLE-SPECIES AND MIXED-SPECIES CULTURES OF Tribolium confusum AND T. castaneum REARED AT DIFFERENT TEMPERATURES. HW-SA-3748, General Electric Co., Richland, Wash Hanford Atomic Products Operation, 1964, 20p.

Adult flour beetles, T. confusum and T. castaneum, sexed as pupae and maintained separately for 3 weeks after adult emergence, were given 0, 1575, or 2625 R of x-rays. Single- and mixed-species populations were established and incubated at 25, 29, or 32°C at 65 to 70% relative humidity. Productivity was determined during 10 weeks post-irradiation. Reproductive abilities increased with increased temperature and decreased with increased x-ray exposure for a given temperature. The reproductive fitness of T. castaneum was superior in all environments except at 0 R, 32°C. The frequencies of dominant lethals (which included lethality due to coexistence in mixed-species populations) increased with higher x-ray doses, but temperature and cohabitation influenced their expression within a species. Coexistence was responsible for a considerable reduction of productivity, which was also altered by temperature and x-radiation. The rigours of coexistence were lessened at 2625 R exposures (undoubtedly due to reduced population density). Interpretations of dose-response curves on the bases of single-hit and multi-hit radiation phenomena were inferred from similar responses of diverse organisms. Most lethality occurred in the early (eggs to young larvae) part of the life cycle for both species. Species proportions in coexistent populations varied with temperature and x-radiation but T. castaneum was consistently superior compared to T. confusum. The greater variability of T. castaneum probably makes it more fit in environments featuring different temperatures and x-radiation exposures plus coexistence. Responses to radiation of single-species populations cannot be used to predict those of mixed-species populations. (Auth.)

924 Myser, W.C. A STUDY OF RADIATION ON THE BIOLOGY AND POPULATION DYNAMICS OF THE CEREAL LEAF BEETLE, Oulema melanopa (L.) ORDER COLEOPTERA, FAMILY CHRYSOMELIDAE. p.66 of "Offsite Ecological Research of the Division of Biology and Medicine Terrestrial and Fresh-water". TID-13358 (2nd rev.), March 1965.

This crop pest became established in Michigan and Indiana and had, by 1964, migrated to north-western Ohio. In order to study the effects of radiation on ecology, including life stage development and behaviour, and to determine the radiosensitivity of the insect and to study its general physiological responses to radiation, a number of experiments are reported as being set up. Rearing facilities are arranged in the laboratory. Germ cell development, the number of eggs laid following adult irradiation, egg viability, life span, sperm viability, and motility are items to be studied, and the existence of a radiation threshold, and radiation levels for inhibiting development and for causing sterility are to be determined.

925 Riordan, D.F. EFFECT OF CONTINUOUS LOW-LEVEL GAMMA-IRRADIATION ON SUCCESSIVE GENERATIONS OF Dahlbominus fuscipennis (Zett.) (HYMENOPTERA: EULOPHIDAE). Can. J. Zool. 42 (1964) 685-8.

The chalcid, a hymenopterous parasite, was γ-irradiated continuously through seven generations; the experiment was halted at this point by lack of host cocoons (D. fuscipennis was reared on larval cocoons of the sawfly Neodiprion lecontei). The dose rates were 10, 5, and 2.5 R/h. At 10 R/h the population failed to reach the third generation. After two generations at 5 R/h the population was reduced in numbers to 20% or less of the control population but managed to survive for the seven generations. At 2.5 R/h the numbers in the first five generations were reduced below those of the controls, but had completely recovered by the sixth generation. The time, in days, between oviposition and emergence in the 7 generations of the untreated controls was 19 - 21. The corresponding times for the groups that were treated at 2.5 R/h were 21 - 25 d. When treatments were at 5.0 R/h, the times to emergence were 23 - 29 d, and for the single generation surviving treatment at 10 R/h 27 d (total dosage 6240 - 6480 R). At 5 R/h the population appeared to have reached a roughly stable state after the second generation. The results of the treatment at 2.5 R/h showed that the numbers of females in the first five generations of progeny fluctuated to some extent but in the same pattern as those in the corresponding control generations. The population had fully recovered by the sixth and seventh generations, and recovery was also apparent in the generations relieved from irradiation. This is further indicated by the manner in which the development times shortened after the second generation. This was a self-accelerating process, as a shorter development time resulted, in turn, in a lesser total dose. These results suggest selection of a radiation-resistant strain of parasites. The small numbers of insects used precluded assessing separate, but interdependent, subeffects; however, data from the 5-R/h treatment show that reduced fertility of the females was the major cause of the lesser numbers of females in the successive generations. (NSA 19:1965, 3918)

926 Sankaranarayanan, K. GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF *Drosophila melanogaster*. *Genetics* *50* (1964) 131-50.

The influence of x-radiation-induced genetic loads on the viability of experimental populations of *D. melanogaster* maintained under relatively relaxed selection conditions was studied. Four dose levels (2000 R, 4000 R, 6000 R and 7000 R) were used and only the males were irradiated. Three populations received radiation in every generation; sub-populations were derived from these after 1, 5, 10, 15, 20, and 25 generations and propagated without further irradiation. The components of viability investigated were hatchability of the eggs, larva-adult survival, and egg-adult survival. In the chronically irradiated populations, viability decreased for the first few generations and then fluctuated about an equilibrium level depending on the amount and the history of the irradiation. The sub-populations derived from the irradiated ones manifested a rapid recovery to almost the control levels of viability in three to seven generations. The preliminary data on chromosome analysis indicate that, under the influence of induced mutation pressure, the populations tend to accumulate recessive lethals and semilethals. The mean viability of the homozygotes for the quasi-normal chromosomes is below that of the heterozygotes. (Auth.)

927 Willard, W.K. LONG TERM EFFECTS OF ACUTE LOW-LEVEL x-RAYS ON THE POPULATION DYNAMICS OF THE YELLOW FEVER MOSQUITO, *Aëdes aegypti*. *Diss. Abstr.* *26*, 4 (1965) 2394.

Four life history stages (eggs, larvae, pupae, and adults) of the yellow fever mosquito, *A. aegypti* (Rockefeller strain), were subjected to acute low-level x-rays. The stages were divided into seven groups; each group received a single dose of x-rays, the dosage ranging from 0 - 3200 R. The following population characteristics were measured through three generations succeeding the irradiation: fecundity, egg viability, larval survival, and mean longevity. Radiation effects of acute low-level x-rays on populations of *A. aegypti* were most evident in the first generation and gradually disappeared in subsequent generations. The eggs were most radiosensitive, followed in rank by larvae, pupae, and adults. Egg viability was the characteristic most drastically affected, in that the viability of eggs produced by adults which arose from irradiated eggs, larvae, pupae, or young adults was reduced, in some cases, through three generations. A dose of 3200 R of x-radiation delivered to *A. aegypti* populations in each developmental stage resulted in the extinction of the populations in the first generation. Only a few eggs or larvae irradiated with an acute dose of 1600 R survived to the adult stage. Pupal populations irradiated with 1600 R of x-rays had a lowered fecundity in the first generation followed by second generation recovery. The fecundity of adults irradiated with 1600 R was significantly lower than the controls in the first and second generations; however, recovery occurred by the third generation. A dose of 800 R to all stages resulted in a significantly

Fecundity, egg viability, larval growth rate, and mean longevity were population parameters utilized in evaluating the long term effects of acute low-level x-rays on eggs, 1st-instar larvae, pupae and adults. Effects were most strongly exerted in the first generation and gradually subsided in subsequent generations. Doses of 50 - 400 R were found to be stimulatory in some cases, while doses of 800 R and above were detrimental. The egg stage was found to be most sensitive followed by the larval, pupal, and adult stages.

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* See also 927.

See also:

675 x-ray and fast neutron effects on productivity of flour beetles. (Erdman, H.E., 1965)
911 Mating preference and reproduction of irradiated *Drosophila melanogaster*. (Mason, H.C. et al., 1965)
957 Changes in an aphid population in a forest community damaged by chronic gamma irradiation. (Brower, J.H., 1964)
958 Ecological changes in the insect community of a pitch pine-oak forest subjected to chronic gamma irradiation. (Brower, J.H., 1965)

3. Physiological Characteristics

See:

926 Genetic loads in irradiated experimental populations of *Drosophila melanogaster*. (Sankaranarayanan, K., 1964)
929 The effects of selection and irradiation on quantitative traits in *Tribolium*. (Bartlett, A.C., Bell, A.E., 1964)
932 Progress report (on genetical studies), 1 October 1963 - 1 June 1964. (Dobzhansky, T., nd)
941 Genetic loads in irradiated populations of *Drosophila melanogaster*. (Sankaranarayanan, K., 1965)
942 Further data on the genetic loads in irradiated experimental populations of *Drosophila melanogaster*. (Sankaranarayanan, K., 1965)
944 Inbreeding and genetic loads in irradiated experimental populations of *Drosophila melanogaster*. (Sankaranarayanan, K., 1965)

4. Genetic Changes

929 Bartlett, A.C., Bell, A.E. THE EFFECTS OF SELECTION AND IRRADIATION ON QUANTITATIVE TRAITS IN *Tribolium*. *Genetics* *50*, 2 (1964) 234. Abstr.

The consequences of various combinations of selection (high and random) and levels of x-radiation (0, 100 and 1000 R/generation) on body weight at the pupal stage were investigated over 11 generations in two strains of *T. castaneum*. Reproductive fitness in terms of fertility, number of offspring, and adult viability was measured each generation. One strain, called Foundation, was an unselected panmictic population which had been maintained since its formation in 1954 by mass cultures containing 250 or more parents each generation. Average body weight of this strain was 2.10 mg. The second strain, referred to as Large, originated from the first and had been selected for a large body weight for 44 generations. At the beginning of the present study, average body weight of the second strain was 5.66 mg. High selection contributed to significant responses in body weight in all lines so treated; but the degree of response was negatively correlated with the amount of irradiation. Even though an increase in the additive genetic variance was observed in some of the irradiated lines, a decline in reproductive fitness contributed to a smaller selection differential. - The results for this experiment suggest that artificial irradiation will not become an efficient method of enhancing response to selection until techniques are devised to eliminate more rapidly those mutations deleterious to reproductive fitness. (Abstr.)

930 Blaylock, B.G. CHROMOSOMAL ABERRATIONS IN A NATURAL POPULATION OF Chironomus tentans EXPOSED TO CHRONIC LOW-LEVEL RADIATION.* Evolution 19 (1965) 421-9.

Salivary chromosomes of larvae from the vicinity of Oak Ridge, Tenn., were analysed. Three paracentric inversions were found at a relatively high frequency (8.7 - 25.3%) in three different populations. Samples from White Oak Creek (contaminated with low-level radioactive waste) were compared with samples from two other populations. The amount of chromosomal polymorphism in the irradiated and non-irradiated populations was approximately the same with an average of 0.53 and 0.55 aberrations/larva respectively. However, ten aberrations which occurred at a very low frequency (nine were found only one time) were unique to the irradiated population. The occurrence of new aberrations in the White Oak Creek population was concluded to increase due to the high background radiation level, but were rapidly eliminated by selection or genetic drift. The frequency of inversion of 1 Ra decreased from 55.6% in Sep. to 16.1% in Dec. During this decrease the observed larval types were significantly different from the expected Hardy-Weinberg frequencies. An explanation is put forward.

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* A thesis of the same title was published in 1963, see II/1388.

931 Clayton, G.A., Robertson, A. THE EFFECTS OF x-RAYS ON QUANTITATIVE CHARACTERS. Genet. Res. 5 (1964) 410-22.

The rate of production by x-rays of new genetic variation in two quantitative characters in Drosophila melanogaster (sternital and sternopleural bristles) was investigated, using plateaued populations which had reached the limit under artificial selection and, for sternital bristles only, populations which were made genetically invariant by inbreeding. The genetic variation was always measured by the response of the population to selection. The x-ray dose given in any generation was always 1800 R to adults. Seven plateaued lines had eight cycles of alternate irradiation and selection, each with its non-irradiated control. All the responses were small but in three lines they were significantly greater after irradiation. Selection was applied to three different inbred lines, genetically marked to detect contamination, after varying periods of irradiation. At the same time, the inbred lines and lines derived from them which had been mass mated in bottles were selected. The irradiated populations showed a greater response. The new genetic variance produced by the irradiation was approximately 10^{-5} units/R. The estimate of the dose required to introduce new variation equal to that in a standard outbred population was 500 000 R. The effective population size was an important factor in the interpretation of some of these results on the long-term effects of radiation. By observing the variation between replicate lines in the frequency of a gene with a visible effect under these culture conditions (i.e. in a single culture bottle) the effective population size was estimated at 60. Outbred populations kept under these conditions for many generations showed a reduction of genetic variability in agreement with this value. To investigate the possibility that the deleterious genes produced by irradiation would interfere with the response to artificial selection, a standard outbred population was irradiated and selected. In spite of the observed high frequency of recessive lethals produced, the response to selection was very similar to that of the standard population. (Auth.)

932 Dobzhansky, T. PROGRESS REPORT (ON GENETICAL STUDIES), 1 OCTOBER 1963 - 1 JUNE 1964. TID-20728, Rockefeller Inst., New York. nd, 9p.

Genetic loads of irradiated experimental populations of Drosophila pseudoobscura were studied, and Malthusian parameters (the innate capacity for increase) were used for statistical fitness estimates at 25° and 16°C. Males were subjected to 16 000 R doses of x-rays, and subsequently crossed with untreated females, followed by free breeding. Examinations made 27 - 37 generations later for lethals and semilethals showed these to decline sharply in both the second and third chromosomes, compared with those in a natural population. At least some of them are by this time neutral or heterotic in heterozygous conditions. The adaptiveness to the environment of the irradiated populations improved by means of increased fecundity in spite of deterioration in longevity, and no change in viability or speed of development. Viability losses were remarkably small. Other work planned and in progress is discussed. (See work by Torroja, Mourad, Sankaranarayanan).

933 Dobzhansky, T. PROGRESS REPORT [ON GENETIC STRUCTURE OF NATURAL POPULATIONS] FOR 1 OCTOBER 1964 - 1 JUNE 1965. TID-22031, Rockefeller Inst., New York. nd, 17p.

Progress is reported in studies of genetic loads in natural and irradiated populations of Drosophila. Data are included from studies of epistatic interactions of the components of the genetic load in natural populations; the relation of genetic loads and genetic backgrounds; the genetic consequences of exposure to doses of 2000, 4000, or 6000 R x-radiation in experimental populations maintained under conditions of relaxed natural selection after exposure for three successive generations; studies of chromosomal polymorphism in natural populations; and genetic diversity and selection in Drosophila populations. (NSA 19:1965, 35948)

934 Eiche, A. DURING SEVERAL GENERATIONS IRRADIATED SPERMATOGONIA IN Drosophila melanogaster. A POPULATION ANALYSIS. Hereditas 52, 2(1964)243. Abstr. Presented at the "3rd Meeting of the Scandinavian Association of Geneticists, Helsinki, Finland, 10 - 12 Jun. 1964".

Two different wild type strains of D. melanogaster were studied during the course of several generations with an x-ray dose to the spermatogonia in each generation. The x-rays were administered to 17 ± 1 h old larvae at which stage only primary spermatogonia are present. The newly irradiated gene mass thus came from the male side in each generation. The effects of the x-rays were not measurable in the individual generations, however, from the total material, based on the number of tested larvae which reached the adult stage, it may be seen that such effects exist. Of the other genetic tests only that for recessive lethals showed a difference between the x-ray and control populations. (Abstr.)

935 Magalhães, L.E. de, Brito da Cunha, A., Toledo, J.S. de, Toledo, S.A., Souza, H.L. de, Targa, H.J., Setzer, V., Pavan, C. ON LETHALS AND THEIR SUPPRESSORS IN EXPERIMENTAL POPULATIONS OF Drosophila willistoni. Mutation Res. 2 (1965) 45-54.

Naturally occurring and radio-induced* lethals were studied in experimental populations maintained in population cages. The populations were started with four lethals, two wild and two induced, each of them having a frequency of 0.25. The lethals still had frequencies from 0.03 - 0.18 when the populations were 348-d-old. Analysis of the lethals showed that all of them were able to survive in homozygous condition. The survival of the flies homozygous for the lethals was due to the presence of recessive suppressors. The proportion of the lethals accompanied by their own suppressors was measured in a sample taken when the populations were 866 d old and varied from 0 - 58.3%. The implications of the presence of suppressors regarding the behaviour of lethals in populations were analysed and the results are discussed. (Auth.)

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* 800 R from a ^{137}Cs-source.

936 Molnar, I., Gubicza, A. THE EFFECT OF GAMMA RAYS ON THE VARO RACE OF Bombyx mori L. (COMPARATIVE STUDY OF THE SECOND GENERATION). Magy. Text-Tech. 17, 3 (1965) 106-8. (In Hungarian)

937 Mourad, A.E.-K.M. LETHAL AND SEMILETHAL CHROMOSOMES IN IRRADIATED EXPERIMENTAL POPULATIONS IN Drosophila pseudoobscura. Genetics 50 (1964) 1279-87.

Experimental Drosophila populations, in which some of the chromosomes were exposed in one generation to 16 000 R of x-rays, were studied approximately $2\frac{1}{2}$ yr later (estimated to correspond to between 28 and 37 generations). Frequencies of the second and third chromosomes lethal, semilethal, and quasi-normal in double dose were determined. Lethals and semilethals were much less numerous than they were immediately after the irradiation, although more frequent than before the irradiation. Few of the quasi-normal chromosomes were subvital in double dose. It is concluded that the genetic variants found in natural and in experimental populations are, because of the action of natural selection, very biased samples of those arising by mutation. (Auth.)

938 Mukai, T. POLYGENIC MUTATIONS AFFECTING QUANTITATIVE CHARACTERS OF Drosophila melanogaster. Gamma Field Symp. 3 (1964) 13-29.

Results are reported from a study of spontaneous and x-ray induced polygenic mutations that affect the quantitative characters of D. melanogaster. The evolutionary significance of polygenic mutations in natural populations and their possible application in animal and plant breeding programmes are discussed. (NSA 20:1966, 18415)

939 Mukai, T., Yoshikawa, I. HETEROZYGOUS EFFECTS OF RADIATION-INDUCED MUTATIONS ON VIABILITY IN HOMOZYGOUS AND HETEROZYGOUS GENETIC BACKGROUND IN Drosophila melanogaster (Preliminary Report). Idengaku Zasshi (Jap. J. Genet.) 38 (1964) 282-7.

Heterozygous effects of mutations induced by low doses of x-irradiation on viability were tested both in otherwise homozygous genetic background and in heterozygous genetic background in D. melanogaster. On the basis of counting approximately 1.46 million flies, it was found that radio-induced mutations that occurred in homozygous genetic background were heterozygously beneficial to their carriers, while those induced in hybrids between individuals originated from two unrelated populations were slightly detrimental to their carriers. (Auth.)

940 Nelson, D.J., Auerbach, S.I., Blaylock, B.G. et al. CLINCH RIVER AND RELATED AQUATIC STUDIES. p.95-104 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn., Oct.1964, 266p.

An increase of newly occurring chromosomal aberrations is reported in the natural population of Chironomus tentans from White Oak Creek. These newly occurring aberrations are eliminated. by selection or genetic drift and are not maintained in the gene pool of the population. The increased mutation rate produced by the chronic irradiation in the White Oak Creek population has not reduced the amount of chromosomal polymorphism in this natural population. (From auth.)

941 Sankaranarayanan, K. GENETIC LOADS IN IRRADIATED POPULATIONS OF Drosophila melanogaster. Diss. Abstr. 25, 6 (1965) 3766.

The influence of radiation-induced genetic loads on the viability of experimental populations of D. melanogaster maintained under relatively relaxed selection conditions was studied. Four dose levels (2000 R, 4000 R, 6000 R and 7000 R) were used. Some populations (II-ER, IV-ER and VI-ER) were irradiated in every generation. In some, the irradiation was relaxed after varying numbers of generations of irradiation at every dose level (II-ER-1, IV-ER-5, VI-ER-10 etc.). The components of viability investigated were (a) the hatchability of the eggs, (b) larva-adult survival, and (c) egg-adult survival. In chronically irradiated populations, viability decreased for the first few generations and then fluctuated about an equilibrium level depending on the amount and the history of the irradiation. The populations relaxed after several generations of irradiation manifested a quick return to almost the control levels of viability in 3 - 7 generations. The preliminary data on chromosome analysis indicates that, under the influence of the induced mutation pressure, the populations tend to accumulate recessive lethals and semilethals. These do not necessarily constitute a dead weight on the population. (DA)

942 Sankaranarayanan, K. FURTHER DATA ON THE GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF Drosophila melanogaster. Genetics 52, 1 (1965) 153-64.

Populations were maintained under conditions designed to minimize the natural selection due to larval competition and crowding, and were maintained under conditions of relaxed natural selection. Males in every generation were irradiated with 2000 R, 4000 R, and 6000 R doses of x-rays. The egg to adult viability was studied. In all populations, viability decreased for the first few generations, and then fluctuated at equilibrium levels depending on the amount and the history of irradiation. Three sub-populations were derived, one from each of the chronically irradiated populations, at the total accumulated dose of 120 000 R. When relaxed from radiation, the sub-populations rapidly recovered in about four to five generations to 70 - 75% viability level. For a given total dose of radiation, the frequencies of accumulated lethals and semilethals vary depending on the number of generations during which the total dose was delivered. Thus, at the cumulative dose level of 120 000 R administered at the rate of 6000, 4000, and 2000 R per generation for 20, 30, and 60 generations respectively, the frequencies of second chromosome lethals and semilethals in the first two populations were close to 90%, compared with only 57% population. The genetic variances of the homozygotes proved higher than in the heterozygotes; the frequencies of subvitals were greater in the heavily irradiated populations than in the others.

943 Sankaranarayanan, K. RELATIVE MAGNITUDE OF GENETIC LOADS IN EXPERIMENTAL POPULATIONS OF Drosophila melanogaster RELAXED FROM x-IRRADIATION. Genetics 52, 2, Pt.2 (1965) 471-2. Abstr.

Three populations were relaxed from x-irradiation after being exposed to a cumulative dose of 120 000 R delivered in 20 (VI-ER-20), 30 (IV-ER-30) and 60 (II-EGR-60) generations, at the rate of 6000 R, 4000 R and 2000 R per generation respectively. The radiations were acute and administered only to the males. The populations were maintained without further irradiation and under conditions designed to minimize the natural selection due to larval competition and crowding. The egg-adult viability in each of these populations rapidly increased and in 4 - 5 generations reached a level of 70 - 75% and has remained there for over 50 generations in VI-ER-20, 40 generations in IV-ER-30 and 30 generations in II-EGR-60. – At the time of relaxation from radiation, VI-ER-20 and IV-ER-30 contained about 90% lethal and semilethal second chromosomes while II-EGR-60 contained only 57% of such chromosomes. After 19 generations of relaxation, the lethal and semilethal frequencies dropped to 76% in VI-ER-20, to 60% in IV-ER-30 and 41% in II-EGR-60. Thus, despite relatively different concealed genetic loads, these populations have similar egg-adult viabilities, suggesting that the magnitude of the concealed genetic loads per se is not a priori an index of the fitness (egg-adult viability in these experiments) of the population. Inbreeding studies are currently underway to estimate the magnitude of the genetic loads in these populations. (Abstr.)

944 Sankaranarayanan, K. INBREEDING AND GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF Drosophila melanogaster. Nature, Lond. 207 (1965) 1216-7.

The magnitudes of the genetic loads in experimental populations was compared. Males were exposed to x-rays for a number of generations (6000 R/generation for 20 generations; 4000 R for 30; and 2000 R for 60), and then maintained for varying periods of time. The populations received a cumulative dose of 120 000 R. A total of 140 single-pair matings were set up per population, and from each of the single-pair progenies, virgin females and males were collected and three types of crosses set up: 1) unrelated (between groups of 10 ♀ from one culture and 10 ♂ from a different culture); 2) brother-sister matings; 3) half-sib matings (a single ♂ was crossed to a ♀ from one culture and 2 d later crossed to a ♀ from a different culture, and from the progenies groups of 10 ♀ and ♂ were taken and intercrossed). The egg-adult viability was studied in the progenies of these three types of mating. The viability in the irradiated populations was lower (see Table 2 for percentages of egg-adult survival). Mean viabilities observed for the inbred and outbred progenies were tabulated (Table 2), and A and B statistics, and the B/A ratios and their standard errors summarized in Table 3. The results are discussed.

945(2) Scossiroli, R.E. INHERITANCE OF QUANTITATIVE CHARACTERISTICS AND METHODS FOR INCREASING THE GENETIC MUTABILITY OF POPULATIONS. May. tudom. Akad. biol. Osztál Közl. 6 (1963) 297-318. (In Hungarian)

Experiments with fruit flies indicated that irradiation of the population results in a faster evolution than is possible with unirradiated groups. Thus, the radioinduced mutability is responsible for the accelerated rate of evolution. The problem of artificial selection was studied on the Drosophila, exposing the first three generations to 3000 R of x-radiation. The inheritance of the variation in the growth of the sternopleural hair was used as the indicator. The results showed that exposure to x-radiation is an effective tool for creating minor gene mutations which result in additive genetic mutability. This new genetic mutability may be used for artificial selection to improve the desired characteristics of plants and animals. The ionizing radiation helps to overcome the establishment of stable levels in the characteristics. Such tests were carried out with economically important plants, such as corn, wheat (T. durum cultivar Cappelli) and tobacco. It was concluded that high exposures, useful for studying the mutation of individual genes, are not suitable for inducing genetic mutability. The optimum irradiation level must be determined separately for each species. (From NSA 19:1965, 15113)

946 Stone, W.S. RESEARCH IN GENETICS TO INCLUDE (1) THE DIRECT AND INDIRECT EFFECTS OF RADIATIONS AND THEIR MODIFICATION ON GENETIC SYSTEMS, AND (2) POPULATION AND EVOLUTIONARY STUDIES OF Drosophila. p.130 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

947 Tobari, I., Nei, M. GENETIC EFFECTS OF x RAYS ON QUANTITATIVE CHARACTERS IN A HETEROGENEOUS POPULATION OF Drosophila melanogaster. Genetics 52, 5 (1965) 1007-15.

An outbred population was exposed to 1000 R of x-rays at 100 R/min. The numbers of abdominal and sternopleural bristles were studied after three generations of random mating. The mean values of the two characters showed no appreciable change due to radiation. In view of the practical equality of positive and negative mutation rates in these characters, this result suggests that the frequencies of positive and negative alleles in the outbred population are nearly equal, on the average. The phenotypic variance was increased in both abdominal and sternopleural bristles. Partitioning of the phenotypic variance has shown that this increase is mainly due to the increase in genetic variance. The increase in genetic variance in sternopleural bristles was also detected by the parent-offspring covariance, which was larger in the irradiated than in the control population. The amount of variance increase per roentgen has suggested that the increase of genetic variance in the irradiated population is caused mainly by mutations at fixed or nearly fixed loci rather than at loci with intermediate gene frequencies. (Auth.)

948 Torroja, E. GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF *Drosophila pseudoobscura*. *Genetics* *50* (1964) 1289-90.

The genetic loads have been studied by two methods. First, the egg-to-adult viability has been determined in the progenies of matings in which the parents were full sibs, half sibs, or not closely related genetically. Secondly, the viability of individuals made homozygous for certain chromosomes by means of a series of crosses was measured in relation to that of their heterozygous siblings. The experiments conducted utilizing both methods lead to concordant results. The recently irradiated populations carry very heavy genetic loads, consisting mainly of genetic variants which are deleterious in heterozygous, and doubtless also in homozygous condition. Some 28 - 37 generations after the irradiation is discontinued, the genetic loads are found very greatly reduced, in fact, reduced below the levels observed in natural populations. The genetic variants composing the genetic loads in natural populations are evidently not random samples of the variants arising by mutation under the influence of irradiation. (Auth.)

949 Vandehey, R.C. GENETIC VARIABILITY IN *Aedes aegypti* (DIPTERA: CULICIDAE). III. PLASTICITY IN LABORATORY POPULATIONS. *Ann. ent. Soc. Am.* *57* (1964) 488-96.

In addition to the analysis of naturally occurring genetic variability, a preliminary investigation was conducted to assay possible effects of radiation. Three groups of mosquitoes were irradiated with γ-rays (2000 R, 3250 R, and 4000 R at 13 000 R/min from a ^{60}Co-source). The method of analysis used was similar throughout, in principle. The TEXAS strain was used for irradiation. Each irradiated male was mated to a virgin female from the stock colony. Their progeny, whether male or female, were backcrossed to stock colony individuals, a mating was designated as the parental generation of the analysis. Visible mutations recovered in the F_1 or F_2 generations could therefore be attributed to irradiation of a particular gamete. An abundance of natural variation was found in *A. aegypti*, not the case in *Culex pipiens* L., or not to any comparable extent. The number of mutations recovered from irradiated material was always less than that from controls. Moreover, the mutation frequency obtained at higher dosages was lower than at 2000 R. However, there was an increase in lethality at higher dosages. Most of the visible mutations recovered from the irradiated material were similar in phenotype to those found in the controls. Only three mutations, Half-genitalia, scale row, and bent wing were unique to the irradiated series. There appeared to be a reduction in the rate of recovery of the naturally occurring mutations, possibly due to selective action of radiation-induced lethality. The need for more work is stressed.

950 Auerbach, S.I. RADIATION EFFECTS ON *Chironomus tentans*. p.312 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr. 1964, 290p.

See also:

915 A study of genetic processes in irradiated populations. I. Numerical dynamics of irradiated populations. (Bileva, D.S., 1965)
917 Population size and genetic load in irradiated populations of *Drosophila melanogaster*. (Carson, H.L., 1964)
926 Genetic loads in irradiated experimental populations of *Drosophila melanogaster*. (Sankaranarayanan, K., 1964)

5. Ecological Aspects

951 Allred, D.M., Beck, D.E. ARTHROPOD ASSOCIATES OF PLANTS AT THE NEVADA TEST SITE. Biological Series, Volume V, Number 2. TID-21394, Brigham Young Univ., Provo, Utah, Sep.1964, 20p.

An ecological study was made of plant-anthropod associations related to the predominant plants in selected plant communities at the Nevada Test Site. Emphasis was placed on the identification of kinds, relative numbers, seasonal incidence, and ecological distribution of the insects relative to the plant communities as well as individual plants of 11 species. (NSA 19:1965, 6901)

952 Auerbach, S.I. RADIATION ECOLOGY. p.43-100 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1965". ORNL-3849, Oak Ridge National Lab., Tenn. Oct.1965, 263p.

Results of investigations concerning radiation effects on insects, plants, and animals in reactor and waste areas are summarized. Investigation results are also summarized on processes and components of terrestrial ecosystems. Clinch River and related aquatic studies are reported along with theoretical studies of food chains and systems ecology. (NSA 20:1965, 0711)

953 Auerbach, S.I., Brown, G.N., Crossley, D.A., Jr. et al. RADIOACTIVE WASTE AREA AND RADIATION EFFECTS STUDIES. p.65-84 of "Health Physics Division Annual Progress Report for Period Ending July 31, 1964". ORNL-3697, Oak Ridge National Lab., Tenn. Oct.1964, 266p.

Statistical analyses of sedges growing on White Oak Lake bed indicated that length of inflorescence was mostly correlated with the air dose rate of γ-radiation at 1 m above ground surface. Some of the natural vegetation around the unshielded Health Physics Research Reactor exhibited the first visible effects of radiation damage. Radiation effects studies completed this year included fast-neutron exposures from the HPRR, and γ-radiation exposures from both a ^{137}Cs field source and the White Oak Lake bed. Insect studies showed that mud-dauber wasps that used radioactive mud from the liquid waste pits were affected by the ionizing radiation. Continuing studies on ^{137}Cs accumulation and elimination by various species of insects demonstrated the usefulness of these techniques for measuring food consumption and insect production under field conditions. Energy flow through the herbivorous insect population was estimated by using food consumption rates calculated with steady-state equilibria for ^{137}Cs. Preliminary studies of radiation response of several insect species including crickets and grain beetles were reported.

954 Blaylock, B.G. CHROMOSOMAL ABERRATIONS IN A NATURAL POPULATION OF *Chironomus tentans* EXPOSED TO CHRONIC LOW-LEVEL ENVIRONMENTAL RADIATION. *Diss. Abstr.* *24* (1963/4) 3022.

For abstract, see 955.

955 Blaylock, B.G., Auerbach, S.I., Nelson, D.J. CHROMOSOMAL ABERRATIONS IN A NATURAL POPULATION OF Chironomus tentans EXPOSED TO CHRONIC LOW-LEVEL ENVIRONMENTAL RADIATION. ORNL-3531, Oak Ridge National Lab., Tenn. 29 Jan.1964, 88p. Thesis submitted to Univ. of Tennessee, Knoxville.

The salivary gland chromosomes of *C. tentans* larvae collected from White Oak Creek, an area contaminated by radioactive waste from the Oak Ridge National Laboratory, and from 6 uncontaminated areas were examined for chromosomal aberrations. White Oak Creek populations were exposed to absorbed doses as high as 230 rad/yr or about 1000-times background. Chromosomal maps were constructed to make a general comparison of the banding pattern of the salivary chromosomes of the *C. tentans* in the East Tennessee area with those of Canada and Europe. These maps were used as a reference in scoring aberrations. Fifteen different chromosomal aberrations were found in 365 larvae taken from the irradiated population as compared with 5 different aberrations observed in 356 larvae from 6 control populations, but the mean number of aberrations per larva did not differ in any of the populations. The quantitative amount of heterozygosity was essentially the same in the irradiated and the control population, but there were 3-times the variety of chromosomal aberrations found in the irradiated area. From this evidence it was concluded that chronic low-level irradiation from radioactive waste was increasing the variability of chromosomal aberrations without significantly increasing the frequency. It was also concluded that chromosomal polymorphism can be maintained in a natural population without superiority of the heterozygous individuals. (NSA 18:1964, 8108)

956(2) Brower, J.H. CHANGES IN INSECT POPULATION IN A NATURAL FOREST COMMUNITY EXPOSED TO CHRONIC GAMMA RADIATION STRESS. Bull. ecol. Soc. Am. 44, 3 (1963) 69. Abstr.

This study was designed to determine basic information about changes in insect populations of a chronically irradiated forest ecosystem. Insect populations of the low shrub synusis were sampled with a standardized sweep netting technique. Since profound changes occurred in the vegetation near the source of radiation, populations of phytophagous species were greatly reduced. Populations of their parasites and predators also reacted similarly. Not all populations of insects were reduced; some actually built up to much greater abundance than in the normal forest. The increase is probably attributable to increased food availability. Although the larger, vegetationally influenced, changes partially masked any direct effects on insects, a number of indications of direct effects were noticed. (Abst.)

957 Brower, J.H. CHANGES IN AN APHID POPULATION IN A FOREST COMMUNITY DAMAGED BY CHRONIC GAMMA IRRADIATION. Bull. ent. Soc. Am. 10, 3 (1964) 172. Abstr.

Population dynamics of an aphid (Myzocallis discolor Monell) were studied in an oak-pine forest community which had been subjected to chronic γ-irradiation for 18 months. This species underwent a population explosion on radiation damaged white oak trees. Possible explanations will be presented. (Abstr.)

958 Brower, J.H. ECOLOGICAL CHANGES IN THE INSECT COMMUNITY OF A PITCH PINE-OAK FOREST SUBJECTED TO CHRONIC GAMMA IRRADIATION. BNL-9253, Brookhaven National Lab., Upton, N.Y. 28 May 1965, 184p. Thesis.

A project was established in 1961 at Brookhaven National Laboratory to study the effects of chronic γ-radiation on the insect fauna of a natural forest community. The area of pitch pine-oak-blueberry was irradiated for 20 h each day with a 9500 Ci ^{137}Cs source. A sweep sampling technique was employed to give reliable samples of the shrub insects. A numerical survey was made to determine the density and distribution pattern of an aphid on white oak leaves along a decreasing radiation gradient. Pines were checked monthly to determine the intensity of bark beetle infestation. Later, squares of the bark were removed and the developmental success was determined by estimating the per cent of cambial surface utilized. Trap logs were also used to provide Ips populations at very high radiation intensities. Radiation had extensive effects on the vegetation of the experimental forest. The abundance of the shrub insects was greatly depleted near the radiation source in the area of severe shrub damage. Omitting Psocoptera, insect abundance was 5% of normal at 10 m. Normal abundance for most species was reached at about 60 m. Near the source, the leaf feeding species and their parasites and predators were mostly absent; the insects present were fungivorous or vagile forms. The fungivorous Psocoptera were normal or above normal in abundance in the area of complete shrub mortality. In 1963, a species of aphid, Myzocallis discolor, was observed on the radiation-damaged white oaks. This aphid was not found in the unaffected forest but increased in abundance on the debilitated oaks to >25 winged aphids/leaf. This increase amounted to as much as 350 000 aphids/m^2 of forest floor area. A possible increase in the soluble amino acid content in damaged leaves was a likely causal factor for the aphid increase. Bark beetles attacked dead and dying trees and the area of infestation increased as pines further from the source died. Trees at high radiation levels were attacked by Ips where the exposure level proved lethal. Several zones of effect on Ips developmental success were recognized at different intensities of exposure. Developmental success was greater on the self-shielded side than on the exposed side of trees. Trap logs were used for studies of developmental success at high radiation intensities. In 1962 development in them was subnormal reaching ~60%, in 1963 total utilization at low radiation intensities approached 100%. The zones of effect were comparable to those in the standing trees. The per cent of cambial surface utilized by Ips increased from 9% at 2300 R/d to ~80% at 300 R/d. The difference between sides of the same log was as great as 30% because of the shielding factor. Ants are the only insects reported to have a radiation avoidance response. The habits of a colony of Formica integra changed so that ants were no longer exposed to high radiation levels. The ants constructed a 12.5 m sunken runway from the nest away from the radiation source and they no longer appeared on the exposed nest snag. – The insect community in the irradiated area was divided into two parts on the basis of food requirements, one ecologically sensitive and the other ecologically resistant. The former was composed of herbivorous populations and their parasites and predators while the latter contained fungivorous, xylophagous, and saprophagous populations, insects favouring debilitated plants, and the parasites and predators of these groups. (From auth. summary)

959 Erdman, H.E. EFFECTS OF RADIATION ON COMPETITIVE INSECTS. p.277 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

960 Woodwell, G.M., Sparrow, A.H. EFFECTS OF IONIZING RADIATION ON ECOLOGICAL SYSTEMS. p.26-27 of "Ecological Effects of Nuclear War". BNL-917, Brookhaven National Lab., Upton, N.Y. Aug.1965, 76p.

Field experiments with small, open, irradiated ecosystems have shown no clear tendency for devastating population explosions of insects after radiation damage, but experience is limited. Principal changes in insect population (cf. Brower) followed changes in abundance of food. Thus bark lice (Psicoptera) and certain beetles (Ips) increased in abundance in the zone of tree mortality. In certain instances there was a clear increase in the amount of damage by herbivorous insects (e.g. aphids). Three categories of radiation effects on ecosystems were established for predicting potential fallout effects.

See also:

310 Transport of radioactive materials by mud-dauber wasps. (Shinn, A.F. et al., 1964)
916 Changes in the insect populations of the low shrub synusia in a natural forest community exposed to chronic gamma radiation stress. (Brower, J.H., 1964)
930 Chromosomal aberrations in a natural population of Chironomus tentans exposed to chronic low-level radiation. (Blaylock, B.G., 1965)
940 Clinch River and related aquatic studies. (Nelson, D.J. et al., 1964)

D. APPLICATIONS

1. General Articles, Surveys, Books

961 Bailey, P.J., Baines, B.D. IRRADIATION: PRESENT AND FUTURE APPLICATIONS. Nucl. Engng 9 (1964) 213-6.

Insect elimination by release of sterile males is discussed and conditions for successful application of the technique are listed. Using radiation to kill or sterilize insects in infected grains to reduce grain losses is also discussed. Food irradiation to kill fruit flies, to improve storage properties, to complete sterilization, and to eliminate salmonella is described. The designs of typical chemical irradiation plants are described, in which radiation is used to promote chemical reactions. Radio-induced sterilization of surgical products is also discussed. Control and measurement of dose is described. (NSA 18:1964, 30080)

962 Ericson, L.-E. FOOD SUPPLY AND ATOMIC ENERGY RESEARCH. TVF 35 (1964) 246-51. (In Swedish)

The importance of atomic energy research to the world food supply is discussed. Ionizing radiation methods are analysed, with special reference to extermination of insects and parasites, disinfection of animal products, food preservation, industrial application, plant breeding, production of vaccines, etc. (Auth.)

963 Jefferson, S., Ed. MASSIVE RADIATION TECHNIQUES. London, George Newnes Ltd. 1964, 324p.

Commercial applications of γ-radiation and high energy electrons are reviewed. The book is divided into sections on the interaction of radiation with matter, biological effects of massive radiation doses in relation to agricultural problems, plant breeding, the sterilization of medical equipment and pharmaceutical products, food irradiation, insect control (see ref.1062), the use of radiation in the chemical industry, radiation sources, and dosimetry.

964(2) Knipling, E.F. DIE SELBSTVERNICHTUNGSMETHODE DER SCHÄDLINGSBEKÄMPFUNG. (The autocidal method in pest control). *Umschau* *63*, 20 (1963) 632-36. (In German)

General article on the principle of the method and achievements to date.

See also:

824 The protection of the olive tree at the present time. (Melis, A., 1962)

2. Population Control

(a) Sterile Male Technique

965 Butt, B.A., Hathaway, D.O. INSECT CONTROL BY THE STERILE MALE TECHNIQUE. (BAg 29: 1965,52591). *Wash. St. Hort. Ass. Proc., 60th A. Meet.* 83 (1964) 86.

966 Diffidenti, G.A. INSETTI STERILIZZATI CON L'ENERGIA ATOMICA. (Insects sterilized with atomic energy). *Agr. d'Ital.* *10*, 2 (1964) 17-29. (In Italian)

Review article.

967 Gibbons, H.L., Dille, J.R., Cowley, R.G. INHALANT ALLERGY TO THE SCREWWORM FLY: PRELIMINARY REPORT. *Archs envir. Hlth* *10* (1965) 424-30.

Following the emergency landing of three light aircraft being used for the aerial dispersal of radio-sterilized screw-worm flies (*Cochliomyia* *hominivorax*) eradication programme, a preliminary survey revealed that $\sim$ 70% of the flight crew members reported developing mild to severe allergic symptoms, after spending from 2 weeks - 6 months in the programme. The radio-sterilized screw-worm flies are being released in the Southwestern United States to combat multimillion dollar losses to the cattle industry. Up to 100 000 000 flies per week are raised in a plant near Mission, Texas. Fertile adult flies lay eggs which hatch into larvae and then transform into the pupal stage. Sexual sterilization is accomplished $5\frac{1}{2}$ d after entering this stage when canisters containing 25 000 pupae are given a dose of about 8000 R of γ-radiation from a ^{60}Co source. The pupae are packaged in boxes of about 400 and placed in holding rooms until they emerge as adults. They are then loaded into aircraft at the plant or trucked in refrigerated vans to other distribution centres. Dispersal is made from 20 light aircraft. Plans for release vary from 200 - 1000 flies/square mile, depending upon the presence or absence of reported infestations in the area. Persons involved in aerial dissemination of irradiated flies experienced significant allergic manifestations, with near disastrous results in some cases. Symptoms consist of eye irritation, nasal congestion, coughing, wheezing, and shortness of breath. The results of a survey of symptoms, dust analysis, skin testing, and case histories are presented. (NSA 19:1965,43652)

968 Katiyar, K.P. CONTROL DE INSECTOS POR MEDIO DE LA TECNICA DE MACHOS ESTERILIZADOS POR RADIACIONES GAMMA. *Boln Jta Control Energía Atómica* *9*, 48 (1964) 25-8. (In Spanish)

The control of insects by γ-sterilization of the males is briefly described, and the advantages of this method are tabulated. The principal studies now in progress on its practical utilization are summarized. (NSA 19:1965,3910)

969 Knipling, E.F. THE POTENTIAL ROLE OF THE STERILITY METHOD FOR INSECT POPULATION CONTROL WITH SPECIAL REFERENCE TO COMBINING THIS METHOD WITH CONVENTIONAL METHODS. ARS-33-98, USDA series. Nov.1964, 54p.

970 Knipling, E.F. THE STERILITY PRINCIPLE OF INSECT POPULATION CONTROL. p.251-2 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 July 1964". Freeman, P., Ed. London, Royal Entomological Society of London, 1965.

Review of various problems involved in the genetic control of insects. A table shows the relative trends of hypothetical insect populations subjected to different systems of control. By means of hypothetical models attempts had been made to appraise the potential role of sterile-insect release in the elimination of various important insects. Two ways of employing sterile-male releases have been considered for controlling populations of tsetse flies. One way involves the use of such releases only to eliminate a low density population. The other method involves the application of a single insecticide mist spray treatment to reduce the natural adult population followed by the sustained release of sterile males. Thus, 1700 fully competitive sterile male tsetse flies/square mile for about one year should eliminate a population that initially averages about 200 flies/square mile. For a population of about 1000 tsetse flies/square mile complete elimination should result from a single insecticide application, followed by the release of about 1500 sterile males during the following 6-12 months.

971 LaBrecque, G.C., Keller, J.C. ADVANCES IN INSECT POPULATION CONTROL BY THE STERILE-MALE TECHNIQUE. Report of a Panel held in Vienna, 20-24 Jul.1964. STI/DOC/10/44, International Atomic Energy Agency, Vienna (Austria). Jun.1965, 81p.

Recent progress in inducing sexual sterility in insects is reviewed. Emphasis is placed on fruit flies and tsetse flies but data are included on 39 species of economic or medical significance. The utilization of radioisotopes for labelling insects for use in ecological studies is also discussed. Dosage and rearing problems for large scale production of the various species (in particular, *Dacus* *oleae* and *Ceratitis* *capitata*) are discussed. The "flushing technique" of overloading natural resources with a sterile population has been tried out in the field in Australie. Other field studies are reported from Costa Rica, Israel, Tunisia (also using ^{32}P), and USA. Increasing attention is being paid to the tsetse fly (*Glossina* *palpalis*) in Central Africa (chemosterilants proving very promising). The screw-worm eradication programme in Texas is discussed. Several other species have been studied, with a view to eventual radiation-induced sterilization (the horn fly *Haematobia* *irritans*, *Drosophila* *melanogaster*, the codling moth *Carpocapsa* *pomonella*, the mallow moth *Pectinophora* *gossypiella*, the European cornborer *Ostrinia* *nubilalis*, *Aedes* *aegypti*, *Calandra* *granaria*, the cutworm moth *Laphygma* *exigua*, *Acanthoscelides* *obtectus*, the cotton bollworm *Chloridea* *obsoleta*, the Colorado beetle *Leptinotarsa* *decemlineata*, *Culex* *fatigans*, *Aedes* *aegypti*, *Anopheles* *quadrimaculatus*. The status of chemosterilants is reviewed in some detail (p.46-52), work being reported on numerous species. The toxicology of chemosterilants is also discussed. Other topics considered are genetic manipulations (incompatibility, hybrid sterility, deleterious genes, gene propagation), adjuncts to the sterility approach, major pitfalls in release programmes, a proposed approach to the study of radiation sterilization and chemical sterilization (including a partial list of insects on which sexual-sterility research has been initiated), the integration of the sterile-insect-release method with other means of control, and finally the theory of dominant lethality. Panel recommendations are summarized.

972 Ramos, V.P. O METODO DOS MACHOS ESTERILIZADOS DE INSECTOS NA LUTA CONTRA AS PRAGAS. (The sterile-male technique in the fight against pests). "Colloquium held at the National Agronomical Station, Oeiras, Portugal, 8 Feb.1964", 25p. (In Portuguese)

Review article. The principles of the method, radiation effects at the cellular level, and the radiosensitivity of the female and the male reproductive systems are discussed, also the results of trials carried out on various species to date, and the conditions under which the technique can be applied with success.

973 Ramos, V.P. THE USE OF STERILIZED MALE INSECTS IN PEST CONTROL. *Gazeta Agric. Moçamb.* *16*, 177 (1964) 47-53. (In Portuguese)

974 Weidhaas, D.E. RESEARCH ON RADIOISOTOPES AND RADIATION IN INSECT CONTROL RELATED TO THE DEVELOPMENT OF THE STERILE-MALE TECHNIQUE. p.189-95 of "5th Inter-American Symposium on the Peaceful Application of Nuclear Energy". Washington, D.C., Pan American Union. 1965.

The use of the sterility principle for the control or eradication of insect pests or vectors of disease offers a new technique in pest control operations. One means of using this new technique is the mass production and release of insects sterilized by γ-radiation into natural populations. The effectiveness of the method has been demonstrated in the successful eradication of the screw-worm fly, Cochliomyia hominivorax, from the island of Curacao and the Southeastern United States. A current programme in the Southwestern United States has demonstrated that a high degree of control of this same fly in a non-isolated area can be achieved by the method. A recent pilot experiment has also demonstrated that the sustained release of sterilized melon flies resulted in the eradication of this pest of vegetables from the island of Rota in the Pacific Ocean. Over the past several years encouraging results have been obtained in preliminary research on the sterile-insect method for controlling several other important insect pests. Results are summarized from research to date and ways are considered whereby the sterile-insect method might be used alone or integrated with other methods to achieve control or eradication of certain insects. The role of radioisotopes in fundamental studies relating to the development of sterile-male techniques is summarized. (Auth.)

See also:

555 Insect gametogenesis as a target. (Virkki, N., 1965)

(i) Coleoptera

975(2) Horber, E. MAIKÄFER GEGEN MAIKÄFER? EIN VERSUCH ZUR VERTILGUNG VON ENGERLINGEN DES FELDMAIKÄFERS (Melolontha vulgaris Fabr.) MIT RÖNTGENBESTRAHLTEN MÄNNCHEN. (Cockchafer against cockchafer? An attempt at eradicating larvae of the field cockchafer Melolontha vulgaris Fabr. by means of x-rayed males). Mitt. schweiz. Landw. 11, 10 (1963) 145-55. (In German)

For maturation feeding and mating cockchafers choose a particular area and return to the original emergence sites for oviposition. Short of overpopulation or exhausted food supplies, the beetles will continue to follow the same pattern of behaviour. These foci of breeding activity and development therefore have the same practical effect as if island populations were to be investigated. From 1955-1962 samples were obtained in three different areas, dug up during a flight year prior to emergence and flight. Subsequently, males were x-rayed with various doses (1000, 2000, 4000, 5000, 6000, 10000, and 20000 R) and then mated with non-irradiated females. The minimal dose for temporary sterilization was 3000 R. No marked alteration in behaviour or life span was observed even after 20000 R. Field trials were made with males irradiated with 3000 - 5000 R (average dose of 3325 R). Test regions were defined, and details of the operation given (marking, irradiation, and release). 3109 Cockchafers were released from an open crate in 1959, 8594 in 1962. The subsequent drop in population was very marked, and the method shows great promise as preventive treatment, even under conditions where mass rearing is not possible, females copulate several times, and the population density in the area considered is low and cannot be dealt with effectively by other means.

See also:

659 The potential application of γ-radiation for the sterilization of Chloridea obsoleta for the purpose of reducing its population. (Andreev, S.V. et al., 1964)

971 Advances in insect population control by the sterile-male technique. (LaBrecque, G.C., Keller, J.C., 1965)

(ii) Diptera

976 Anonymous. CONTROL OF MEDITERRANEAN FRUIT FLY IN CENTRAL AMERICA. Pl. Prot. Bull. F.A.O. 13, 2 (1965) 47-8.

A project to eradicate Ceratitis capitata (Wied.) from Costa Rica by the release of sterile males is in progress. Between July 1963 and September 1964, over 110 million pupae of the fruit fly were reared from about 190 million eggs, over 63 million pupae were irradiated from a ^{60}Co source and over 60 million adults from the irradiated pupae were released over an area of about 2 - 5 square miles on the Puntarenas peninsula, where the principal host-fruit of the fly (available all the year) is Terminalia cattapa. Monthly releases were begun in July 1963 and increased from January 1964, irradiated pupae being set out in cages from which the adults (which emerged 12 - 24 h later) were able to escape. The releases were sufficient to outnumber the existing fly population by 40 : 1, and the percentage of Terminalia fruits infested, which was 38-52 in Aug. - Dec. 1963 and 49,5 in Jan. 1964, fell progressively until it was only 3 in Sep. 1964. It is considered that more laboratory work and larger releases over greater areas will be required if the technique is to be improved. (RAE-A 53:1965, 545)

977 Anonymous. ORIENTAL FRUIT FLIES ...... GONE FROM GUAM. Agric. Res., Wash. 13, 11 (1965) 12-13.

The sterile male technique was applied to the control of Dacus dorsalis on the island of Guam. Large numbers (20 × 10^6) of sterile males were released in 1963, at a cost of 4 cents/acre. This is of particular interest when compared with the cost of conventional chemical control measures.

978 Cohen, I. INSECT CONTROL BY THE STERILE MALE TECHNIQUE. Haklauth Israel 10, 4 (1965) 45-46.

The article is mostly concerned with Ceratitis capitata.

979 Donnelly, J. POSSIBLE CAUSES OF FAILURE IN A FIELD TEST OF THE "STERILE MALES" METHOD OF CONTROL. p. 253 of "Proceedings of the 12th International Congress of Entomology, London, 8-16 Jul. 1964". Freeman, P., Ed. London, Royal Entomological Society of London. 1965.

After release of large numbers of γ-radiation-sterilized Lucilia sericata into a small, apparently isolated, population for two seasons, reliable estimates showed that the population had not even been reduced. Various aspects of the test are examined for any evidence of possible causes of failure. No clear-cut cause could be demonstrated. Serious impediments to the success of the method may have existed in the sector of release and maintenance of adequate numbers of adequately viable, sterile individuals. Both males and females are sterilized by doses of 4500 rep and above. Material for release was treated with 6000 or 7000 rep, at which dose adult longevity was reduced to 60% of normal. There was evidence that the sterile male was not as effective as the normal in achieving a second copulation, and was incapable of a third. Normal males, on the other hand, average at least six and are sometimes capable of up to twelve copulations. Due to the fact that neither sex can mate within their first three adult days, thus allowing for some dispersal, the danger of absorption of the total potency of a sterile male by a single sterile female is reduced.
An unknown and possibly serious loss of effective sterile population may have occurred due to:
(a) serious depredation at emergence while large numbers of newly emerged flies were aggregated at the release sites; (b) loss of viability inherent in laboratory strains under field conditions;
(c) very low emergence rates in released material during the first season especially; (d) vulnerability of young material to extreme weather conditions.

980 Feron, M. STERILISATION DE Ceratitis capitata PAR LES IRRADIATIONS. Interim Report, received July 20, 1964. 5p. (mimeographed)

En conclusion d'une première série d'essais, il apparaît à l'échelle du Laboratoire que les meilleures conditions, pour obtenir une stérilité presque totale des mâles, soient faites d'une dose de 8 à 10 kR appliquées à des pupes de 8 jours. Pour être efficaces, les mélanges de population doivent être de l'ordre de 30 insectes stériles pour 1 fertile.

981 Hightower, B.G., Adams, A.L., Alley, D.A. DISPERSAL OF RELEASED IRRADIATED LABORATORY-REARED SCREW-WORM FLIES. J. econ. Ent. 58, 2 (1965) 373-4.

The initial release point was on the Colorado River about 15 miles NE of Llano, Texas. About 200000 flies, marked with red or blue dye, were released at weekly intervals from 25 Apr. - 15 Nov. 1964. In late July, the release point was moved 120 miles up the Colorado River. All traps were placed along the Colorado and Concho Rivers. A maximum dispersal range of 180 miles for individual flies was obtained.

982 Hightower, B.G., Alley, D.A. OBSERVATIONS ON THE EFFECTS OF RELEASING STERILE SCREW-WORM FLIES IN NORTHWESTERN VERACRUZ, MEXICO. Bull. ent. Soc. Am. 11, 3 (1965) 173. Abstr. 376. Presented at the "Annual Meeting of the Entomological Society of America, New Orleans, 29 Nov. - 2 Dec.1965".

The feasibility of controlling screw-worm flies over large areas by releasing sterile flies on flight lanes 8 miles apart was tested in northern Veracruz, Mexico. Promising results were obtained in areas with low populations of native flies, but increasing populations in favourable environments were not controlled. (Abstr.)

983 Husman, C.N. USE OF AIRCRAFT IN THE ERADICATION OF SCREWWORMS IN THE SOUTH-EASTERN UNITED STATES. Int. agric. Aviat. Conf. (1964) 56-57. (4th International Agricultural Aviation Conference. 1962).

Use of sterile-fly technique for controlling Cochliomyia hominivorax. (BAg 30:1966,4784)

984 International Atomic Energy Agency, Vienna (Austria). APLICACIONES DE ENERGIA NUCLEAR EN ENTOMOLOGIA. Boln Jta Control Energía Atómica 9, 48 (1964) 103-6. (In Spanish). Translation of Circular Letter SC/822-2.

Four possible projects for the eradication of insects using male sterilization by γ-radiation and supported by the IAEA are described. The insects to be eradicated are the Mediterranean fruit fly, the olive fly, locusts, and the tsetse fly. The cost of a coordinated investigation to determine the feasibility of the projects is estimated.

985 Katiyar, K.P., Valerio, J. EFECTO CAUSADO POR LA INTRODUCCION DE MACHOS ESTERILIZADOS POR RADIACION GAMMA, EN UNA POBLACION NORMAL DE MOSCAS DEL MEDITERRANEO (Ceratitis capitata). (Effect of introducing males sterilized by γ-radiation into a normal population of Mediterranean fruit fly (Ceratitis capitata). Turrialba 14, 4 (1964) 211-12. (In Spanish, with English summary)

The males were exposed to 10 kR of γ-radiation from a ^{60}Co source, at 1600 R/min. A reduction in sexual vigour and fertility was observed.

986 Katiyar, K.P., Valerio, J. FURTHER STUDIES ON THE POSSIBLE USE OF STERILE-MALE RELEASE TECHNIQUE IN CONTROLLING OR ERADICATING THE MEDITERRANEAN FRUIT FLY, Ceratitis capitata Wied., FROM CENTRAL AMERICA. p.197-202 of "5th Inter-American Symposium on the Peaceful Application of Nuclear Energy". Washington, D.C., Pan American Union, 1965.

Since its recent appearance (1955) in Costa Rica, the Medfly has produced a highly adverse effect on the local fruit industries. In spite of strict quarantine regulations observed on the country's two frontiers, the fly has managed to cross the borders. It has already spread into Nicaragua and is reported recently to have entered Panama. The Medfly meets all the basic requirements for control by the sterile male technique. A cooperative project between the Inter-American Institute of Agricultural Sciences and the Organismo Internacional Regional de Sanidad Agropecuaria (OIRSA) has been under way for the past two years to explore the feasibility of this method of control under Central American conditions. Irradiation tests carried out with a ^{60}Co pool irradiator have shown that males irradiated with 10 000 or 12 500 R at a 7-, 8- or 9-d-old pupal stage produce sperms with almost 100% dominant lethal factors. Females treated at similar stages do not lay eggs beyond 7500 R. Such pupal treatment inhibits neither the adult's emergence nor decreases its subsequent survival rate. Contrariwise, a slight increase in the longevity of the adults, especially females, was noticed when flies were treated with 10 000 or 12 500 R at the 7-d-old pupal stage. Irradiated males do not seem to compete equally with normal males in insemination. In a laboratory test in small cages, overflooding of the normal population by 39-times with sterile flies reduced the fertility of normal females by 89%. To test the laboratory findings in the field, weekly releases of more than half a million irradiated flies have been under way since May 1963 in a small semi-isolated test area of $\sim 4\ \text{km}^2$. (Auth.)

987 Moh, C.C. STERILIZATION OF MEDITERRANEAN FRUIT FLY. p.419 of "Research and Development in Progress. Biology and Medicine. No.3". Abstr. TID-4203, Division of Technical Information Extension, (AEC), Oak Ridge, Tenn. Apr.1964, 290p.

988 Moh, C.C. THE APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. TID-20708, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica. 1 July 1964, 76p.

Section D (p.51-67) deals with the sterilization of the Mediterranean fruit fly and its application to fly eradication. Studies include work on mating behaviour; single- and multi-mating effects on egg hatch; effects of alternate matings of normal and sterile males on fertility; effect of cage size on fertility; field test with sterile releases (release of $\sim 120\,000$ ^{32}P-labelled adults at Chacarita in April 1964 showed that allowances must be made for the constant migration of released flies). The study of the ecology of the tropical warble fly, Dermatobia hominis Linn., and a method of control, with a view to applying the sterile male technique are considered on p.67-8.

989 Morales, E. ACTIVITIES OF THE MEDFLY INVESTIGATION SECTION DURING JULY 10, 1963 - JUNE 30, 1964 ON INSECT CONTROL BY RADIATION, OIRSA, SAN SALVADOR, EL SALVADOR. NP-15348, Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador). nd, 19p.

Procedures used for the rearing and radiation exposure of massive numbers of Mediterranean fruit flies are discussed. Adult flies were exposed to 10 000 R γ-radiation and pupae were exposed to 2500 R. Several hundred thousand adult flies were released in a test area to study the effects of sterile adults on population control. Preliminary results are reported. Studies were also conducted on the biological control of the Mediterranean fruit fly by parasites and the behaviour of the flies, in which flies marked with radioisotopes or colour points were released. (NSA 20: 1966,12633)

990 Morales, E. SUMMARY OF THE MEDFLY INVESTIGATION SECTION'S ACTIVITIES DURING THE PERIOD JUNE 1964 - MARCH 1965 ON INSECT CONTROL BY RADIATION. NP-15349, Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador). nd., 13p.

Procedures for the rearing of mass numbers of Mediterranean fruit flies, exposed to ^{60}Co γ-radiation during various developmental stages, and the marking of irradiated flies with fluorescent powders are described. Preliminary results are reported from studies on the effects of the release of radiation sterilized flies on populations of the insects in Nicaragua and Panama. (NSA 20:1966,12634)

991 Organismo Internacional Regional de Sanidad Agropecuaria, San Salvador (El Salvador). SUMMARY OF THE MEDITERRANEAN FRUIT FLY INVESTIGATION PROGRAM JUNE 1964 THROUGH MAY 1965. OIRSA-AID-USDA-AIEA-IICA. 1965, 81p.

A number of tests were made, in the laboratory as well as in the field, to obtain information to improve the massive reproduction technique and release of sterile Ceratitis capitata. Techniques of mass rearing, sterility determinations for flies after ^{60}Co irradiation, mortality of sterile flies released in the field, a technique for marking adults of sterile flies, and optimum temperature conditions during rearing, just prior to emergence, and prior to release are among the problems studied. Numerous tables are given. The preliminary aspect of the work is stressed.

992 Smith, C.L. THE STERILE SCREWWORM FLY PRODUCTION PLANT. "Proceedings of the 14th Annual Meeting. Texas Agricultural Aviation Conference and Short Course Pest Control, B1-B8. 1965".

993 Soria, F. PERSPECTIVES DE LUTTE BIOPHYSIQUE CONTRE Ceratitis capitata Wied. EN TUNISIE. Documents Techniques 8 (1965) 9p. Tunisia. Institut National de la Recherche Agronomique, Ariana.

994 Steiner, L.F., Harris, E.J., Mitchell, W.C., Fujimoto, M.S., Christenson, L.D. MELON FLY ERADICATION BY OVERFLOODING WITH STERILE FLIES. J. econ. Ent. 58, 3 (1965) 519-22.

The melon fly, Dacus cucurbitae Coquillett, was eradicated from the 33 square mile island of Rota, M.I., by the release of 257 million flies irradiated as pupae with 9.5 kR from a ^{60}Co source.

Pupae were produced in Hawaii and air shipped 3800 miles. Releases were made from both air and ground at weekly intervals between Sep.1962 and July 1963. They were preceded by low-cost applications of concentrated protein hydrolyzate-malathion bait sprays, limited to about 20 of the principal fly-producing sites. Predators, off-island drift, and shorter life of boxed flies reduced the efficiency of the releases. Fruit infestations disappeared late in December 1962 and none occurred in 1963. Sterile eggs were found until the end of February 1963. Sterile flies of both sexes congregated in host plantings, the same as wild flies, but sting damage by females was far less per female than by wild individuals. Some sterile flies of each sex lived 4 months after the last release. (Auth.)

See also:

632 How far a fly can fly. (Anonymous, 1965)
637 The effect of cobalt 60 gamma rays on the biology of the eye gnat, Hippolates pusio Loew. (Flint, H.M., 1965)
907 Field behavior of sexually sterile Anopheles quadrimaculatus males. (Dame, D.A. et al., 1964)

(iii) Lepidoptera

994-a Bulyginskaya, M.A. THE POSSIBILITY OF UTILIZING GAMMA RAYS FOR SEXUAL STERILIZATION OF THE MALLOW MOTH (Pectinophora malvella Hb.). Dokl. Akad Nauk SSSR (1963) 76-78. R. Zh. Biol. No. 1E180. 1964. Presented at: "Fifth Conference of the All-Union Entomological Society, 1963".

995 Graham, H.M., Glick, P.A., Ouye, M.T., Martin, D.F. MATING FREQUENCY OF FEMALE PINK BOLLWORMS COLLECTED FROM LIGHT TRAPS. Ann. ent. Soc. Am. 58, 4 (1965) 595-6.

Studies on the possibility of controlling Pectinophora gossypiella (Saund.) on cotton by the release of sterile males created interest in the frequency of mating of the females in the field. Dissection of females taken in light traps in Texas in 1962-63 indicated that, although multiple mating occurred, single mating was by far the commonest. During the early part of the season, while the population was still low, there was a high proportion of unmated individuals, and in view of this and the high mortality of young larvae during this period releases of sterile males would best be made at this time. (RAE-A 53:1965,514)

996 Husseiny, M.M., Madsen, H.F. STERILIZATION OF THE NAVEL ORANGEWORM, Paramyelois transitella (Walker), BY GAMMA RADIATION (LEPIDOPTERA: PHYCITIDAE). Hilgardia 36, 3 (1964) 113-37.

The studies described were directed towards the control of P. transitella (Wlk.) on almonds and walnuts in California by the release of insects sterilized after γ-irradiation (from a ^{60}Co source). Laboratory culture required a high relative humidity and good indirect air circulation. Successful mating was obtained at temperatures between 10° and 16°C, with a light intensity similar to that of the early-morning hours. Temperatures of about 28°C favoured growth and development. Irradiating eggs or larvae did not give complete sterility without injurious effects and high mortality. Common injuries were failure to pass a critical stage of development, delayed metamorphosis and deformation of pupae or adults. Mature pupae about 8-d-old best tolerated irradiation and also were convenient to handle. Both sexes were sterilized completely by exposure of the mature pupae to a dose of 50 000 rad, and this treatment did not seem to affect mating habits, egg-laying or length of adult life. A dose of 40 000 rad very nearly sterilized most of the pupae treated, but not with sufficient certainty for use in a control project. Multiple matings were fairly common but would not interfere with the success of a control programme. At least one female mated 5 times, and some males mated 3 times and probably more. The most important result of the work was the demonstration that sterile females of P. transitella can be used for autocidal control as successfully as sterile males. Adding both sterile males and sterile females to a normal population gives two-way competition for the normal mates and does not simply add but actually multiplies the probabilities of sterile matings by the normal males and the normal females. (Based on auth. summary)

997 Katiyar, K.P., Ferrer, F. STERILIZATION OF THE MEDITERRANEAN FRUIT FLY AND ITS APPLICATION TO FLY ERADICATION. p.69-94 of "The Application of Nuclear Energy to Agriculture. Annual Report". NYO-2043-108, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica. 1 Jul.1965, 107p.

Experiments were carried out to obtain detailed information on the fertility of females which first mate with a normal and later with an irradiated (sterile) male, or vice versa (p.69-73). The sterile males were obtained by irradiating pupae with a dose of 10 000 R 24 h prior to adult emergence. First mating of virgin females and males was permitted when the adults were 5 d old. Eggs were collected daily. A second mating with appropriate males was permitted a week later. The results which are tabulated indicate that the effect of matings with normal males subsequent to sterile matings is almost twice as great (as far as the fertility of the females is concerned) as when sterile matings follow the normal ones. - The effect of humidity on egg-hatch of the Medfly is described on p.74-84. An evaluation of the performance of four different types of yeasts in the larval diet is given on p.94-93, and the report finishes with a brief note on the progress of the cooperative project with OIRSA (Organismo Internacional Regional de Sanidad Agropecuaria (Central American Phytosanitary Organization)) on the Medfly (p.94).

998 Proverbs, M.D. THE STERILE MALE TECHNIQUE AND ITS POSSIBLE USE FOR CODLING MOTH ERADICATION. Can. Ent. 96 (1964) 143.

When mature male pupae of the codling moth, Carpocapsa pomonella (L.), were subjected to 40 000 rad of γ-radiation, dominant lethals were induced in at least 98% of the sperm without affecting adult emergence, mating, or adult longevity. Higher exposures reduced the frequency of mating. The female codling moth was more radiosensitive than the male. In general, radiosensitivity of both sexes decreased as development progressed from the egg to the adult stage. The progeny that survived from normal females x irradiated (30 000 rad) males were at least 89% male; female progeny were completely sterile, males mostly so. When irradiated males (exposed as mature pupae to 40 000 rad) were confined over dwarf apple trees with normal males and normal females in the proportion of 10 : 1 : 1 the reproductive potential, based on the numbers of mature larval progeny, was reduced 85%. When the ratio was 20 : 1 : 1 the reproductive potential was reduced 98%. The sterile male technique is now being tested for codling moth eradication in an isolated apple orchard in the Okanagan Valley of British Columbia.

999 Proverbs, M.D., Newton, J.R., Logan, D.M. PROGRESS REPORT ON CODLING MOTH CONTROL BY THE STERILE MALE TECHNIQUE. WP/31/7. p.31. 1964-1965. Unpublished work.

1000 Katiyar, K.P., Ferrer, F. EVALUATION OF THE STERILE MALE TECHNIQUE FOR CONTROLLING THE COFFEE LEAF MINER, Leucoptera coffeella Guer. p.97-102 of "The Application of Nuclear Energy to Agriculture. Annual Report". NYO-2043-108, Inter-American Inst. of Agricultural Sciences, Turrialba, Costa Rica. 1 Jul.1965, 112p.

After discussing the damage due to the leaf miner and its biology, the authors consider the theoretical suitability of the sterile male technique to control measures against the pest. With regard to possible rearing, larval duration is short (~3 weeks) and the amount of food consumed by an individual larva very little. Although no leaf miner has so far been reared on an artificial diet, several leaf-feeding Lepidoptera have been reared successfully. The dispersion of the (winged) moth should present no problems following release. The miner population fluctuates greatly, reaching some very low seasonal levels when release of irradiated males would be very effective. The adults of the leaf miner are non-destructive to man, animals, and plants. The only stage damaging to plants is the larva, so that sterile males would not cause any additional damage on release. Insecticides used so far did not affect the pupa in its silken cocoon but did affect beneficial insects. The sterile male technique therefore appears to be very promising for controlling the coffee leaf miner.

See also:

633 Effect of gamma radiation on the sterilization of Corcyra cephalonica Stanton (Lep.: Pyralidae). (Atwal, A.S., Sethi, S.L., 1964)
635 Suppression of the reproductive potential of the potato tuberworm, Gnorimoschema operculella by gamma irradiation. (Elbadry, E., 1964)
647 Lethal and sterilising effects of cobalt-60 gamma rays on Argyroploce leucotreta. (Myburgh, A.C., 1963)

(iv) Hemiptera

See:

639 Gamma radiation and the reproductive behavior of male *Rhodnius prolixus*. (Gomez-Numez, J.C., 1964)

(b) Overloading Resources

See:

971 Advances in insect population control by the sterile-male technique. (LaBrecque, G.C., Keller, J.C., 1965)

3. Infestation and Countermeasures

(a) Stored Products

1001 Cornwell, P.B., Bull, J.O., Pendlebury, J.B. CONTROL OF WEEVIL POPULATIONS (*Sitophilus granarius* (L.)) WITH STERILISING AND SUBSTERILISING DOSES OF GAMMA RADIATION.* p.71-95 of "Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966**, 236p.

The efficacy of 16 000 rad, recommended for industrial applications of γ-radiation for the control of insects in grain, is substantiated by the complete sterilization and death of 10 million insects of a wild strain of grain weevil under conditions simulating bulk storage. Substerilizing doses of 10 000 - 14 500 rad suppress weevil populations to a very low level and prevent their increase for 4-8 months; this period of "short-term" control is related to the size of the population and oxygen tension at irradiation. The reproductive potential of fertile and subfertile grain weevils is depressed when added to large irradiated populations; partial protection to the grain against reinfestation is afforded by the insemination of contaminants with sterile sperm, which remains competitive within the female and with fertile sperm subsequently inseminated, for periods greater than 4 months. A reduction in reproductive potential of weevils which may be underdosed at irradiation gives considerable flexibility to the requirement of dose uniformity in plant design for disinfestation of grain. (Auth.)

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* For an earlier report of the same title, AERE-R-3892, see II/1479.

** Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

1002 Laudani, H., Tilton, E.W., Brower, J.H. USDA RESEARCH PROGRAM AND FACILITIES FOR THE USE OF GAMMA IRRADIATION IN THE CONTROL OF STORED-PRODUCT INSECTS. *Fd Irrad.* *6* (1965) A6-A9.

A ^{60}Co irradiator for grain disinfestation to be located at Savannah, Georgia, is described. The pilot plant, which will be operated by the USDA, will be located near to a railroad spur in an arrangement such as to permit continuous grain flow. Total activity of the ^{60}Co source will be about 26 000 Ci and capacity of the irradiator will be from 2500 - 10 000 lb of grain/h. In addition to bulk grain irradiation, packages and bags of a large range of processed agricultural commodities, including various cereals and grain products, dried fruit and nuts, and legumes may be processed in a separate section of the irradiator designed for package handling. Research will be oriented toward establishing: the minimum effective lethal dose for use in packaging plants where complete and immediate mortality of the insects is required; and the minimum effective dose to induce dominant lethal genes, thereby breaking the reproductive cycle of the insects. (NSA 20:1966,19124)

1003 Marzke, F.O. IRRADIATION STUDIES WITH INSECTS INFESTING BULK GRAIN AND PACKAGED COMMODITIES. p.53-55 of "Radiation Pasteurization of Foods. Summaries of Accomplishment". Presented at the "5th Annual Contractors Meeting, 20-21 Oct.1965". CONF-651024, nd, 210p.

Construction of a bulk grain and packaged commodity irradiator at Savannah, Ga., is reported to be almost completed. Results are reported from preliminary studies on the radiosensitivity of insects infesting stored products. Insects were exposed to doses of 10, 20, 30, 50, or 100 krad γ-radiation during the egg, larva, pupa, and adult stage. The merchant grain beetle and the almond moth, *Cadra cautella*, were both found to be very radiosensitive. (NSA 20:1966,9324)

1004 Ross, E. DOSIMETRY, TOLERANCE, AND SHELF-LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. p.49-52 of "Radiation Pasteurization of Foods. Summaries of Accomplishment". Presented at the "4th Annual Contractors Meeting, 21-22 Oct.1964". CONF-641002, Division of Isotopes Development, AEC *and* Division of Biology and Medicine, AEC. 216p.

Practically all fruits and vegetables, and some flowers, are subject to rigid plant quarantine restrictions for out-shipment to the Mainland USA from Hawaii. The present commercial variety of pineapple, which does not carry fruit fly infestation, is permitted for shipment without restrictions. Fumigation by ethylene dibromide is required prior to shipment for papaya fruits. Since 1954 the Hawaii Fruit Fly Investigations Laboratory, USDA, has been developing information on ionizing radiation dosage requirements to obtain disinfestation. A 416-Ci ^{60}Co-facility was installed at that time for this purpose. Experiments to date have indicated that low dosages of 20 - 25 krad can effectively disinfest papaya, cucumber, lychee, and tomato. Insect species were found to vary in susceptibility and fruit varieties to vary in tolerance. Mango fruits present a special problem by reason of seed weevil infestation. Although naked weevils can be sterilized or killed with 25 krad, those in the seeds inside the fruit resist external dosages up to 100 krad. Present evidence indicates that γ-irradiation dosages to prolong the shelf-life would be sufficiently high to ensure disinfestation.

See also:

641 Susceptibility of the saw-toothed grain beetle, *Oryzaephilus surinamensis* (L.) to gamma radiation. (Jefferies, D.J., 1966)

647 Lethal and sterilising effects of cobalt-60 gamma rays on *Argyroploce leucotreta*. (Myburgh, A.C., 1963)

651 Some effects of gamma radiation on *Rhizopertha dominica* (F.), *Cadra cautella* (Wlk.), *Plodia interpunctella* (Hübn.) and *Lasioderma serricorne* (F.). (Pendlebury, J.B. et al., 1966)

653 Susceptibility of Australian strains of *Sitophilus* and *Tribolium* species to gamma radiation. (Shipp, E., 1966)

656 Sterilizing effects of gamma radiation on eight insect and one mite species that infest stored products. (Tilton, E.W. et al., 1964)

811 Susceptibility of the grain and rice weevils, *Sitophilus granarius* (L.) and *Sitophilus zeamais* Mots. to gamma radiation. (Cornwell, P.B., 1966)

846 Irradiation studies with insects infesting bulk-grain and packaged commodities. (Tilton, E.W., Brower, J.H., 1965)

877 Effects of ionizing radiation on pests in cereals. II. Effects of cobalt-60 radiation on *Tyroglyphus farinae* mites. (Szyszko, E., et al., 1962)

883 The effect of culture environment on the susceptibility of *Sitophilus granarius* (L.) to gamma radiation. (Bull, J.O., Cornwell, P.B., 1966)

1009 The possibility of using the ^{60}Co radioisotope against grain storage insects. (Blazek, J. et al., 1964)

1010 The entomology of radiation disinfestation of grain. (Cornwell, P.B., 1966)

1012 Application of ionizing radiation to grain disinfestation. (Goresline, H.E., 1965)

1014 Effects of continuous and fractionated doses of gamma radiation on the survival and fertility of *Sitophilus granarius* (L.). (Jefferies, D.J., 1966)

1018 Dosimetry, tolerance, and shelf life extension related to disinfestation of fruits and vegetables by gamma irradiation. (Ross, E., Brewbaker, J.L., 1965)

1019 Disinfestation of dried fruits. (Shchegoleva, G.I., 1963)

(b) Disinfestation Measures (Sources. Conveyor Systems. Etc.)

1005 Cornwell, P.B. RADIATION DISINFESTATION OF GRAIN - THE LAST 5 YEARS. Fd Irrad. 6 (1965) A2-A5.

Development of the programme for radiation disinfestation of grain is reviewed. The events that have taken place over the past five years are surveyed as a background to the joint action now being taken by the IAEA and FAO to establish a pilot plant for evaluating radiation disinfestation of grain as an industrial process in Turkey. It is concluded that at best radiation disinfestation is an additional insecticide technique, which is never likely to replace present practices, but may be considered as an alternative where conditions are favourable for its application. (NSA 20: 1966,19123)

1006 Anonymous. THE UNIVERSITY OF HAWAII IS AWAITING DELIVERY OF A 30000-CURIE ^{60}Co IRRADIATOR. Nucleonics Week 5, 46 (1964) 4.

The pool-type facility - Mark IV of a model designed at Brookhaven National Labs and already in use at several US universities - will be used in experimental irradiation treatment of papayas, pineapple and mangos. The food container, which is manipulated inside the 12 ft deep tank by a hoist, can be temperature-controlled from 20-150°F. Additional tubes holding small canisters can be used for small batch tests. (From citation)

1007 Anonymous. AGRICULTURE DEPARTMENT (THE) HAS AWARDED TWO COBALT CONTRACTS .... Nucleonics Week 6, 17 (1965) 5.

(Agriculture Dept. has awarded two cobalt contracts) "to American Nuclear Corp., Oak Ridge. One involves encapsulation of 30 000 Ci for a new and versatile research irradiator at North Carolina State Univ. USDA's Entomology Research Div. is supplying the Co, and a grant from the State's Board of Science & Technology will finance the facility, on which AMF Atomics (in its first irradiator proposal) is apparent low bidder. The second USDA order is for 2800 Ci of ^{60}Co, its encapsulation and construction of five insect sterilization units. These will be scattered from Mexico to Oregon for experiments in the eradication of a variety of fruit and crop pests. The North Carolina State irradiator, designed by Martin Welt, university director of nuclear science & engineering, will feature a second, higher specific-activity ^{60}Co source (5000 Ci at 50 Ci/g) in a variable-intensity irradiator, which Welt says will permit very precise dosages. The second source will be ordered soon". (Direct citation)

1008 Boisot, M., Henrion, B. PROCEDE ET INSTALLATION POUR LA DESTRUCTION D'INSECTES PAR RAYONNEMENTS NUCLEAIRES. Prop. ind. nucl. 7, 18 (1964) 76.

Procédé de stérilisation d'insectes par radiations nucléaires comportant deux stades: 1) attraction des insectes par émanations d'un produit chimique contenu dans des coupelles, par exemple: -1,2-sec-butyl 6-methyl 3-cyclohexene 1-carboxylate, ou l'essence d'angélique, ou analogue pour la mouche des fruits; -1,2-sec-acétoxy 1-hydroxy-cis-9-octadécine pour le bombyx; 2) stérilisation par une source radio-active (émetteur β ou γ) disposée dans un container à l'intérieur d'un logement de béton, et fermé par un bouchon solidaire d'un couvercle amovible sur lequel sont fixées les coupelles. (Res.)

1009 Blazek, J., Dockal, J., Kolin, J. THE POSSIBILITY OF USING THE ^{60}Co RADIOISOTOPE AGAINST GRAIN STORAGE INSECTS. Mlynsko-Pekarsky Prumysl 10 (1964) 636-9. (In Czech)

Containers with grain, to which were added 30 live grain beetles (Calandra granaria L.) and grain that had beetle eggs, were exposed to various doses of ^{60}Co γ-radiation. A 5000-rad dose was sufficient to exterminate the beetles, their eggs, and larvae. Three arrangements for irradiation of grain are described. In two cases, the grain would be irradiated as it passed slowly into the silo. The third, and recommended arrangement, involved the placement of a metal tube along the shaft of the silo. The source would be suspended inside the tube on a cord, which could be unwound and wound by a motor at the top of the tube or pipe. The radiation source could be raised or lowered to obtain the desired exposure. (NSA 19:1965,32630)

1010 Cornwell, P.B., Ed. "The Entomology of Radiation Disinfestation of Grain". Oxford, Pergamon Press. 1966, 236p.

The work had been carried out by the Entomology Group of the Wantage Research Laboratory in 1955-61. This group was established as part of the contribution of the United Kingdom Atomic Energy Authority to the finding of possible industrial applications of the new sources of radiation now available. The book contains a foreword by H. Seligman, an introduction by the Editor (pp. xi-xx), who reviews the necessity for the treatment of stored grain to free it from insect pests and the development of the use of ionizing radiation for this purpose, and a final discussion by him (pp. 187-227, 2 pages of references), in which he surveys the various problems that may arise in the application of radiation for the disinfestation of grain as an industrial process. The bulk of the book consists of 13 scientific papers, with summarized findings and conclusions.

1011(2) Farkas, H., Kiss, I., Razga, Z., Vas, K. EXPERIMENTS ON THE INFLUENCE OF IONIZING RADIATIONS ON THE GROWTH OF BREWING BARLEY. Brauwissenschaft 16 (1963) 483-91. (In German)

The effects of 250-kV x-rays in doses varying from 1.5 - 50 krad on the sprouting of barley to be used in brewing were investigated. The x-rays were applied during steeping or at different points during germination to study the development of root growth in barley. It was found that radiation doses of over 12 krad exert an inhibitory action on the development of the roots but do not arrest the growth of tips and tendrils. The radiation could be used conveniently during storage of the barley since it also has a lethal action on insect pests which normally contaminate the grain, and thus prevents damage by them. The action of radiation doses of 25-800 krad was therefore investigated on air-dried barley (moisture content 11.1%). On the basis of a 4-d growth test, it was established that steeped barley of moisture content of 35 - 45% is 5 times more sensitive to radiation than air-dried barley. Radiation sensitivity is increased both with increasing moisture content above 16.3% and when it is lowered from 13.7 - 9.5%. During storage of the irradiated air-dried barley for 7 months, no regeneration was observed. A close relation was found between the increase in malt yield and the reduction of the growth of roots obtained after irradiating the grain. After treating the air-dried barley with doses of 50 - 100 krad, the malting loss was reduced by 1 - 2%. All qualitative characteristics of the malts prepared from the irradiated barleys were satisfactory. The increase in malt yield obtained by irradiation occurred without disturbance of the enzymic processes which occur during germination. (From NSA 20:1966,10619)

1012 Goresline, H.E. APPLICATION OF IONIZING RADIATION TO GRAIN DISINFESTATION. Fd Irrad. 6 (1965) A10-A12.

Genesis of a pilot plant in Turkey for the radiation disinfestation of grain is discussed. The installation will consist of a ^{60}Co irradiation unit of approximately 150 000 Ci located in an operating grain terminal as an independent unit that will not interfere with the normal operation of the terminal. The pilot plant will be used to study the effectiveness of grain radiosterilization under actual commercial conditions and to identify the problems that would be encountered in applying the method to all grain taken into a large operating terminal. (NSA 20:1966,19125)

1013 Henderson, L.P. RADIATION TREATMENT OF GRAIN AND GRAIN PRODUCTS. p.8-9 of "Radiation Pasteurization of Foods. Summaries of Accomplishment". Presented at the "4th Annual Contractors Meeting, 21-22 Oct.1964". CONF-641002, Division of Isotopes Development, AEC and Division of Biology and Medicine, AEC. 216p.

An extensive study was conducted to determine the gross effects of γ-radiation on the Indian meal-moth, Plodia interpunctella; the Angoumois grain moth, Sitotroga cerealella; the lesser grain borer, Rhyzopertha dominica, the confused flour beetle, Tribolium confusum; the rice weevil, Sitophilus oryzae; the cigarette beetle, Lasioderma serricorne; the black carpet beetle, Attagenus piceus; Trogoderma glabrum; and the grain mite, Acarus siro. Dosages included 13.2 kR, 17.5 kR, 25 kR, 45 kR, and 100 kR. Three of the species of beetles were also treated at a fractionated dosage of 13.2 kR ± 10% repeated 5 times at hourly intervals. All metamorphic stages of the test insects were used in tests. In all species of beetles, the adults were the most tolerant of radiation, followed by the pupae, then the larvae, while the eggs were the most susceptible. No dosage used was sufficiently high to produce immediate complete mortality of all species. Sterility occurred following γ-radiation of a single continuous dose of 25 kR or more. The results of the fractionated dosage indicate that the total effect is not cumulative. (NSA 19:1965,15947)

1014 Jefferies, D.J. EFFECTS OF CONTINUOUS AND FRACTIONATED DOSES OF GAMMA RADIATION ON THE SURVIVAL AND FERTILITY OF *Sitophilus granarius* (L.).* p.41-56 of "The Entomology of Radiation Disinfestation of Grain". Cornwell, P.B., Ed. Oxford, Pergamon Press. 1966**, 236p.

Megacuric sources of ^{60}Co are required to disinfest grain at 16 500 rep (≡ 16 000 rad), the dose level evaluated for commercial treatment, at conveyor rates normally encountered in grain handling. Maximum efficiency in the use of irradiation plant might be obtained with sources of lower curie strength to ensure continuous operation if the full dose for sterilization could be given in a process of repeated passes. The question arises as to whether many sublethal and substerilizing doses would provide the same measure of control as continuous treatment. A study of dose fractionation on the grain weevil shows differences in survival and fertility which may be attributed to "recovery" of somatic and reproductive cells between treatments. Differences in survival were obtained in all developmental stages; recovery was obtained with intervals of 10 min and longer, the process being governed by the number of fractions, the fractional dose, interval time and interval temperature. Recovery in reproductive capacity was obtained in irradiated eggs, larvae and pupae, but not in adults. Whilst these effects are manifest at low doses, fractionated treatment does not adversely affect the degree of control achieved at the commercial dose level. (Auth.)

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* For an earlier paper of the same title see II/1363.

** Since the work reported in this volume was carried out by the Entomology Group of the Wantage Research Laboratory, U.K.A.E.A., during the period 1955-61, individual papers are included in the present bibliography although they were actually not published in book form until 1966.

1015 Leggo, D., Gellatley, J.G., Seberry, J.A., Peggis, I.D., Long, J.K., Hall, E.G. POST-HARVEST STERILIZATION OF ORANGES AGAINST QUEENSLAND FRUIT FLY. *Fd Preserv. Q.* *24*, 1 (1964) 15-9.

For quarantine purposes, New Zealand has recently officially recognized ethylene dibromide fumigation of packed oranges as an acceptable measure against Queensland fruit fly. Irradiation as a possible method of post-harvest sterilization of fruit against fruit fly is also being studied. In conjunction with the Australian Atomic Energy Commission the Division of Food Preservation of CSIRO is carrying out studies in this field. So far it has been found that Queensland fruit fly in oranges can be killed by low doses of γ-radiation, but it is not certain whether rind injury can be avoided. It is thought that when suitable commercial irradiation facilities become available, irradiation may prove a useful method of quarantine treatment.

1016 Lowenberg, H., Morton, M.R. BULK GRAIN IRRADIATOR (BGI) AND MOBILE GAMMA IRRADIATOR (MGI). p.70-72 of "Radiation Pasteurization of Foods. Summaries of Accomplishment". Presented at the "5th Annual Contractors Meeting, 20-21 Oct.1965". CONF-651024, nd, 210p.

The design features are described of a bulk grain irradiator under construction at Savannah, Ga. The facility has the capability of supplying a disinfestation dose of 25 000 rad ^{60}Co γ-radiation at a grain flow rate of 5000 lb/h, with a dose max./min. ratio of less than 1.65. It also has a package handling capability for irradiating such packaged products as cake mixes, flour, and raisins. Design features are also described of a mobile γ-irradiator capable of being transported by road from one harvesting area to another. It is designed to process 1000 lb/h of a product, such as strawberries, at a radiopasteurization dose between 175 000 and 225 000 rad or it can process large quantities of a product, such as potatoes or onions, at a desprouting dose of between 5000 and 15 000 rad. (NSA 20:1966, 9326)

1017 Menhinick, E.F. DESIGN OF ^{90}Sr SOURCES FOR ECOLOGICAL STUDIES INVOLVING BETA IRRADIATION. ORNL-TM-997, Oak Ridge National Lab., Tenn. 11 Nov.1964, 17p.

Three ^{90}Sr - ^{90}Y sources containing 0.08, 0.8, and 8.0 Ci respectively, giving surface dose rates of approximately 100, 1000, and 10 000 R/h, respectively were designed for ecological studies. These sources will consist of $^{90}SrCl_2$ mixed with sodium silicate and painted on transite plaques which will then be placed in leak-tested aluminium source holders. These sources will be used for acute and chronic β-irradiations of insects, studies in radiation detection by insects, glass rod dosimetry research, and tissue absorption studies. (Auth.)

1018 Ross, E., Brewbaker, J.L. DOSIMETRY, TOLERANCE, AND SHELF LIFE EXTENSION RELATED TO DISINFESTATION OF FRUITS AND VEGETABLES BY GAMMA IRRADIATION. p.43-48 of "Radiation Pasteurization of Foods. Summaries of Accomplishment". Presented at the "5th Annual Contractors Meeting, 20-21 Oct.1965". CONF-651024, nd, 210p.

Results of a study of the effects of low dose γ-radiation on the control of decay microorganisms, insect disinfestation, fruit ripening, and extension of refrigerated storage life of tropical fruits showed good results for papayas and mangoes. Mangoes are attacked by the seed weevil, *Sternochetus mangiferae*. A dose of > 75 krad proved lethal within 2 weeks, whereas 20 krad caused sterility. The studies encourage shipping and marketing tests of these fruits. Studies on pineapple and lychee fruits showed that radiation processing extended the shelf life of whole pineapple by 7 - 10 d but produced colour and flavour changes in pureed pulp. No significant differences were found in the aroma, flavour, or texture of radiative processed lychee, but highly significant colour changes were found in whole, unpeeled fruits treated with 25 - 200 krad γ-radiation and stored at 35° F for 4 - 5 weeks. Data are included on the effects of γ-radiation on enzyme and pectin content of the fruits.

1019(2) Shchegoleva, G.I. DISINFESTATION OF DRIED FRUITS. *Zashch. Rast.* Pt. 9 (1963) 14-15. (In Russian)

Insects and mites infesting dried fruits in factories in Fergana (Uzbekistan) and Kanibadam (Tadzhikistan), in Soviet Central Asia, and work on their control are reviewed. The most important pests are *Plodia interpunctella* (Hb.), *Ephestia elutella* (Hb.), *Oryzaephilus surinamensis* (L.), *Tribolium confusum* Duv. and *Tenebroides mauritanicus* (L.). In 1951-53, effective programmes of control with fumigants were developed using ethylene dichloride alone or mixed 3:1 with ethylene dibromide, or 3:2 with carbon tetrachloride. In 1954-55, a system of control by heat was applied commercially in one factory, in which a variety of infested dried fruits were exposed for 25-30 min to a temperature of 60-85° C [140-185° F]; complete control resulted. In tests on control by γ-radiation from a ^{60}Co source applied at a rate of 2000 R/min, a dose of 70 000 rad was sufficient to kill most pests within 2 weeks, but one of 300 000 rad was necessary for satisfactory control of Dermestids and mites. (RAE-A 53:1965,389)

1020 Smith, T.L. A SERVICEABLE IRRADIATOR-SHIELD DEVICE. *Ann. ent. Soc. Am.* *58*, 2 (1965) 245-7.

The author describes the design of a device in which a radioactive isotope (^{60}Co) can be stored and which can also be used for irradiating insects or other small objects. The device was made up at the local workshop at very low cost. By inserting a small, electrostatic-ionization-chamber type of dosimeter into the empty, troughlike space in the servicing shaft, and calibrating the emission rate of the isotope, a rate of R/s values is established.

1021 Vitro Engineering Co., New York, N.Y. PRELIMINARY DESIGN REPORT - TITLE I ON BULK GRAIN IRRADIATOR. KLX-1869, 27 Jan.1965, 68p.

The Bulk Grain Irradiator will be capable of delivering γ-radiation doses in the disinfestation range (approximately 25 000 rad) to handle 5000 lb/h of grain at this dose. The bulk grain will be loaded into a hopper outside the irradiator from whence it will be carried by conveying equipment through the irradiation section. The grain will leave the irradiation cell by means of a pressurized air system. The bulk grain may be stored in any of the bins provided by the USDA located either inside or outside of the building. It also may be delivered directly into railway cars located at the nearby spur. In addition, packages and bags of a large range of products, including dried fruit, peanuts, cereals, grains and flour, may be processed in the section of the irradiator designed for package handling. The packaged products will be arranged in aluminium carriers and loaded automatically into the package handling section of the irradiator from the interior of the building. Work space and storage space for the packaged product are provided in that vicinity. It is expected that initially packaged products will be irradiated. Bulk grain irradiation is not likely to occur in substantial volume until approximately a year after the completion of the facility. The same source material will be used for both the bulk grain and the package handling part of the irradiator. (Auth.)

See also:

641 Susceptibility of the saw-toothed grain beetle, Oryzaephilus surinamensis (L.) to gamma radiation. (Jefferies, D.J., 1966)

651 Some effects of gamma radiation on Rhizopertha dominica (F.), Cadra cautella (Wlk.), Plodia interpunctella (Hübn.) and Lasioderma serricorne (F.). (Pendlebury, J.B. et al., 1966)

653 Susceptibility of Australian strains of Sitophilus and Tribolium species to gamma radiation. (Shipp, E., 1966)

759 Strontium-90 - Yttrium-90 beta source. (Menhinick, E.F., 1964)

811 Susceptibility of the grain and rice weevils, Sitophilus granarius (L.) and Sitophilus zeamais Mots. to gamma radiation. (Cornwell, P.B., 1966)

870 Susceptibility of laboratory and wild strains of the grain weevil Sitophilus granarius (L.) to gamma radiation. (Cornwell, P.B., 1966)

872 The effect of dose rate on the response of Tribolium confusum Duv., Oryzaephilus surinamensis (L.) and Sitophilus granarius (L.) to Co^{60} gamma radiation. (Jefferies, D.J., Banham, E.J., 1966)

877 Effects of ionizing radiation on pests in cereals. II. Effects of cobalt-60 radiation on Tyroglyphus farinae mites. (Szyszko, E. et al., 1962)

883 The effect of culture environment on the susceptibility of Sitophilus granarius (L.) to gamma radiation. (Bull, J.O., Cornwell, P.B., 1966)

899 The influence of temperature upon the radiation susceptibility of Sitophilus granarius (L.). (Pendlebury, J.B., 1966)

1001 Control of weevil populations (Sitophilus granarius (L.)) with sterilising and substerilising doses of gamma radiation. (Cornwell, P.B. et al., 1966)

1002 USDA research program and facilities for the use of gamma irradiation in the control of stored-product insects. (Laudani, H. et al., 1965)

1003 Irradiation studies with insects infesting bulk grain and packaged commodities. (Marzke, F.O., 1965).

1004 Dosimetry, tolerance, and shelf-life extension related to disinfestation of fruits and vegetables by gamma irradiation. (Ross, E., 1964).

(c) Economics

See:

1007 Agriculture department (the) has awarded two cobalt contracts .... (Anonymous, 1965)

1010 The entomology of radiation disinfestation of grain. (Cornwell, P.B., 1966)

1012 Application of ionizing radiation to grain disinfestation. (Goresline, H.E., 1965)

1014 Effects of continuous and fractionated doses of gamma radiation on the survival and fertility of Sitophilus granarius (L.). (Jefferies, D.J., 1966)

1021 Preliminary design report - Title I on bulk grain irradiator. (Vitro Engineering Co., New York, N.Y., 1965)

(d) Detection and Damage Assessment

1022 Aebersold, P.C., Rotariu, G.J., Weiss, F.J. WORLDWIDE STATUS OF NUCLEAR APPLICATIONS TO THE WOOD, PAPER AND PULP INDUSTRIES. p.27-47 of "Nuclear Application to the Wood, Paper, and Pulp Industries Conference". Pullman, Wash., Washington State University, 1964.

Review of the applications and uses of isotope and radiation technology in the major foreign countries of the world in their wood, paper and pulp industries. Some reference is made to non-destructive tests for determining decay resistance and insect damage of wood used in poles or in underwater constructions. Since decaying wood absorbs much faster than healthy wood, a simple and reliable decay test is possible using ^{192}Ir salt solutions. Marine piling which supports many docks and other marine constructions is often infested with marine borers. Piling thus becomes weakened and may give way under stress. The Battelle Memorial Institute, Columbus, Ohio, has developed a γ-radiographic method using thulium-170 for the underwater inspection of 3.5 in. thick waterlogged marine piling.

1023 Berryman, A.A. IDENTIFICATION OF INSECT INCLUSIONS IN x-RAYS OF PONDEROSA PINE BARK INFESTED BY WESTERN PINE BEETLE, Dendroctonus brevicornis LeConte. Can. Ent. 96, 6 (1964) 883-8.

A guide to the interpretation of x-ray radiographs of samples of the bark of ponderosa pine (Pinus ponderosa) infested with D. brevicornis and its principal predators and parasites is presented. Diagrammatic and photographic illustrations of the radiographic images are given to enable analysts to gain experience more rapidly. (From auth.)

1024 DeMars, C.J., Jr. CORRECTION TO "A COMPARISON OF RADIOGRAPH ANALYSIS AND BARK DISSECTION IN ESTIMATING NUMBERS OF WESTERN PINE BEETLE". Can. Ent. 97, 2 (1965) 206.

Corrections applied to table I [see Can. Ent. 95:1963, 1112-6, and II/1509]; the correlation coefficient for "Pupae plus Adults-Live" is changed from "poor" to "fair" (r = 0.7675 instead of 0.5546).

1025 Fatzinger, C.W., Dixon, J.C. USE OF x-RAYS TO DETECT SOUTHERN PINE BEETLES IN SHORT-LEAF PINE BARK. J. For. 63 (1965) 451-5.

The larvae of Dendroctonus frontalis Zimm. mine away from the bark/wood intersurface as they mature, and complete their development in the outer bark. Late instar larvae, pupae, and adults are in the outer bark. To estimate population levels of the southern pine beetle, brood counts are made of a large number of bark samples which are removed and dissected, a tedious and time-consuming technique. A method of sampling by x-rays is described. Rectangular 3- × 6-in. bark samples, $\frac{1}{8}$ - $\frac{1}{2}$ in. thick were removed at 5 ft height intervals along the bole of felled infested pines. Bark samples were maintained in a portable cooler. Field-collected bark samples were x-rayed with a Kelket x-ray unit (300 mA, 125 kV power max.), eight samples being x-rayed simultaneously. Beetle images on radiographs were counted and the results compared with those obtained from dissection. Analysis of the data demonstrates approximately equal accuracy for both methods. The x-ray method, however, is more rapid and far less expensive.

1026 Graham, H.M., Robertson, O.T., Martin, D.F. RADIOGRAPHIC DETECTION OF PINK BOLL-WORM LARVAE IN COTTONSEED. J. econ. Ent. 57, 3 (1964) 419-20.

Soft x-rays were tested. The use of open cotton bolls had to be abandoned. Exposures of 17 kV and 600 mA-s were most favourable for 100-g samples of seed cotton and cottonseed ginned from 100- and 150-g samples of seed cotton. Exposures of 900 mA s were required for optimum darkening in 150-g samples of seed cotton. For the detection of bollworm larvae (Pectinophora gossypiella (Saunders)) the radiographic technique has considerable merit, particularly when many samples need to be examined and when detection of every larva is not necessary; when it is, however, careful dissection remains the best procedure.

1027 Howe, R.W., Currie, J.E. SOME LABORATORY OBSERVATIONS ON THE RATES OF DEVELOPMENT, MORTALITY AND OVIPOSITION OF SEVERAL SPECIES OF BRUCHIDAE BREEDING IN STORED PULSES. Bull. ent. Res. 55, 3 (1964) 437-77.

The rate of development of six species of Bruchidae including four species of Callosobruchus attacking stored pulses was studied over a wide range of constant temperature and humidity and the rate of oviposition of five of them investigated over a range of temperatures at 70% R.H. and a range of humidities at 30°C. Treatment with soft x-rays was restricted to times when identifiable incidents were expected to occur (e.g. the period of pupation, the appearance of windows to give warning of the event), since moulting could not be detected and larvae could not with certainty be assigned to instars. In order to divide the period of pupation into its two parts, pupa and quiescent adult in seed, about 1/5 of the windows were removed so that the transformation from pupae to adult could be observed. This also enabled a check to be made of the correctness of the timing of pupation as inferred from x-ray photographs of pupae of C. rhodesianus.

II/1515 Hurlock, E.T. DETECTION OF INSECTS IN DRIED PEAS. x-RAYS SHOW MOST PROMISE AMONG 8 METHODS. Fd Mf. 38, 7 (1963) 367-9.*

An investigation was carried out on dried peas to determine whether some of the methods used for grain could be extended to pulses and to compare the results obtained by the various methods for reliability and accuracy. The x-ray method was found to be accurate, reliable, and rapid.

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* No abstract available in Vol.II.

1028 Knight, F.B., Albertin, W. PORTABLE x-RAY EQUIPMENT IN FORESTRY RESEARCH. J. Forestry 63, 7 (1965) 543-4.

A Picker 50 kV x-ray unit, successfully adapted for field use was tested in studies of a variety of forest insects without destroying their habitat. They were the twig-boring insect Oberea schaumii Lec. (habits and developmental rate), the white-pine weevil Pissodes strobi (Peck), the poplar and willow weevil Sternochetus lapathi (L.), the pitch nodule borer Petrova albicapitana Busck on jack pine, the jackpine shoot borer Eucosma sonomana Kearfott on jack pine, conemoths, and other borers in aspen. Insects at various positions, up to 6-8 ft up the trees were photographed by adapting the equipment accordingly. Routine procedures (monitoring, transport, field conditions) are described.

1029 Soares de Gouvein, A.J., Moreira, M.I. USE OF x-RAYS TO EVALUATE THE EFFECTIVENESSS OF INSECTICIDE TREATMENTS. Garcia de Orto 10, 4 (1962) 661-65. (In Portuguese)

The use of x-rays was compared with the usual process of examination of F_1 or F_2 (1st or 2nd generation). The efficacy of phytopharmacological products on immature forms of insects whose progenitors had been treated with insecticides was determined. The studies were carried out on one of the "cultivated types" of the common bean (Phaseolus vulgaris) from Angola, and Zabrotes subfasciatus and Acanthoscelides obtectus, which are the most important pests of beans in that territory. In the insecticide applications, inert dust (diatomite and kaolin) and lindane dusts, containing diatomite and kaolin, were used. A considerable economy of time is obtained by using the x-ray method. (CA 62:1965,12388)

1030 Wickman, B.E. A COMPARISON OF RADIOGRAPHIC AND DISSECTION METHODS FOR MEASURING SIRICID POPULATIONS IN WOOD. Can. Ent. 96, 3 (1964) 508-10.

Correlation coefficients were calculated for the estimates of insect density obtained by radiographs versus dissection, and for the estimates obtained by radiographs versus radiographic guided dissection. Estimates of numbers of siricids (Sirex longicauda Middlk. (Hymenoptera: Siricidae)) in white fir obtained by the two methods were closely correlated. The radiographic methods are more accurate than dissection alone, and also faster and cheaper.

4. Sericulture*

1031(1) Kipiani, R. Ya., Tsetskhladze, T.V. THE KILLING OF SILKWORM PUPAE AND THE PRESERVATION OF SILKWORM COCOONS BY GAMMA RAYS. Soobshch. Akad. Nauk gruz. SSR (1957) 657-662. (In Russian)

1032(2) Molnar, I., Babos, L., Gubicza, A., Lukacsovics, F. RADIOAKTIV SUGARAKKAL ELÖLT SELYEMGABOKKAL KAPCSOLATOS VIZSGÁLATOK. (The killing of cocoons by irradiation from radioactive sources). Magy. Text-Tech. 15 (1962) 196-99. (In Hungarian)

1033 Molnar, I., Gubicza, A., Babos, L. A STUDY OF SILK COCOONS FROM THE EGGS OF Bombyx mori L. IRRADIATED WITH Co^{60}. Magy. Text-Tech. 16 (1964) 449-51. (In Hungarian)

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* See also Bombyx mori
silkworm.

Eggs of Varo silkworms at various stages of their development (10 h to the last embryonic stage) were exposed to 200 - 7000 and 100 000 R doses of ^{60}Co γ-radiation. The high dose was lethal. The quality of the cocoons exposed to 200 R was nearly identical to the control group. Increased irradiation (3000 - 5000 R) brought about an increased number of deformed and dead cocoons and decreased the silk content of the cocoons and the length of the spinnable fibres; these cocoons were also smaller than the controls. The characteristics of the next generation of each subgroup will be studied. Improvements are expected in these. (NSA 19:1965,24302)

1034 Tazima, Y. "The Genetics of the Silkworm". London, Logos Press, Prentice Hall, Inc. 1964, 253p.

This is a treatise on the development of the silkworm from mating to the spinning of raw silk. It explains the embryology, chromosomogenesis, heredity, sex determining factors and cocoon colours produced by carotinoids in detail. Other factors such as voltinism, moultinism, natural mutations, hormones, artificial parthenogenesis and radiation induced mutations are discussed less completely. The appendix contains a list of silkworm genes issued by the Science Council of Japan in 1953. This is a useful book for the scientist engaged in scientific work, but it is too technical for most practical sericulturists. (BA 45:1964,102888)

5. Biological Control

1035 Balock, J.W. DIFFERENTIAL EFFECT OF GAMMA RADIATION ON FRUIT FLIES AND FRUIT FLY PARASITES. J. econ. Ent. 58, 6 (1965) 1169.

In conducting experiments in Hawaii to determine the use of gamma radiation as a quarantine treatment for destroying infestations of the oriental fruit fly, Dacus dorsalis Hendel, and the Mediterranean fruit fly, Ceratitis capitata (Wiedemann), in fresh fruits and vegetables, the author observed that parasitization was quite high in many of the wild fruits treated. Flies and parasites were counted in treated and non-treated false kamani (Terminalia catappa L.), T. chebula Retz., ball kamani (Calophyllum inophyllum L.), hog plum (Spondias mombin L.), guava (Psidium guajava L.), strawberry guava (Psidium cattleianum Sabine), and acerola or Barbados cherry (Malpighia glabra L.). Parasites appeared to be more resistant to γ-radiation than their fruit fly hosts. Higher parasite survival occurred at all dosages tested but differences were most apparent at the lowest dosages of 1000 or 2000 R. At these dosages higher parasite survival than in non-irradiated controls suggested a beneficial rather than harmful effect, although the effect may have been due to errors in estimating populations. (Auth.)

See also:

890 Synergistic action of radiation and of Bacillus thuringiensis toxin in protozoan diseases of insects. (Jafri, R.H., 1963)
891 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1964)
892 Influence of pathogens on the life span of irradiated insects. (Jafri, R.H., 1965)
893 Prospects of integrated radiation and microbial control of harmful insects. (Jafri, R.H., 1965)

6. Disease Control

1036 Ayuzawa, C., Yusa, F. ON THE INACTIVATION OF THE VIRUSES OF THE SILKWORM, Bombyx mori L., BY ^{60}Co-GAMMA RAY IRRADIATION. Nippon Sanshigaku Zasshi (J. seric. Sci., Tokyo) 33, 2 (1964) 130-33. (In Japanese)

See also:

896 The treatment with x-rays of eggs of Bombyx mori L. parasitized by Nosema bombycis Naeg. (Masera, E., 1965)

7. Miscellaneous

1037(2) Kurir, A. MÖGLICHKEIT DER BEKÄMPFUNG DER TERMITEN MIT ATOMMÜLL. (Possibility of controlling termites with atomic waste). Holzforsch. Holzverwert. 15, 4 (1963) 67-70. (In German)

In connection with the finding of Reticulitermes flavipes (Koll.) in Austria, the author suggests that atomic waste might be used for the control of termites in open country. Such waste is available from nuclear reactors. Waste containing ^{60}Co giving off relatively low doses of γ-radiation could be lowered into the soil in probes of lead or refined steel surrounded by concrete in close proximity to queens and replacement queens, the object being to affect the gonads of both sexes and bring about negative gene mutations in the heterochromosomes resulting in progressive reduction in reproductive capacity over several years. ^{90}Sr could also be used, but is less suitable. The limitations of such a method, the necessary precautions, and the details of application and the periodic monitoring of the level of radioactivity round the probes are discussed. (RAE-A 53:1965,519)

1038 Popa, A., Mihalache, G. A CONTRIBUTION TO THE UTILIZATION OF RADIOACTIVE TRACERS IN THE PROTECTION OF FORESTS. Rev. Padurilor 87, 2 (1965) 59-62. (In Rumanian)

See also:

1041 The development of a gamma radiographic method for the underwater inspection of marine piling. (Battelle Memorial Institute, 1956)

ADDENDUM

A. TECHNIQUES

1. Autoradiography

See:

53 Sites of fibroin formation in the silk gland in Bombyx mori. (Akai, H., Kobayashi, M., 1965)

82 Autoradiographic study of protein-producing cells. (Makarov, P. V., 1965)

100 Acetylcholinesterase in motor end-plates evaluated by electron microscope autoradiography. (Salpeter, M. M., O'Connor, A., 1965)

161 An autoradiographic study of RNA synthesis in isolated salivary glands of Drosophila hydei. II. Interferometric studies. (Pollister, A. W., 1965)

237 Incorporation of labelled thymidine into the silk gland of the silkworm. (Akai, H., Kobayashi, M., 1965)

248 Application of the autoradiographic technique to the study of the excretion in the coleopterous insect Tenebrio molitor L. (Marcuzzi, G., Degasperi, P., 1964)

2. Dosimetry

See:

1005 Radiation disinfestation of grain–The last 5 years. (Cornwell, P. B., 1965)

3. Isotope Dilution

See:

334 Determination of the content of γ-hexachlorocyclohexane in technical samples by using isotope dilution with ^{36}Cl. (Sieber, K. et al., 1964)

1023 Identification of insect inclusion in x-rays of ponderosa pine bark infested by western pine beetle, Dendroctonus brevicomis LeConte. (Berryman, A. A., 1964)

4. Labelled Pool Technique

See:

79 Amino acid requirements for the wheat stem sawfly determined with glucose-U-C^{14} after vacuum-infiltration. (Kasting, R., McGinnis, A. J., 1964)

83 Glycine catabolism in Blattella germanica (L.). (Mansingh, A., 1965)

88 Rate of incorporation of amino acids into the web proteins of the spider Araneus diadematus Cl. (Peakall, D. B., 1963)

91 Nutritionally essential amino acids of Rhodnius prolixus (Stål) determined with glucose-U-^{14}C. (Pickett, C., Friend, W. G., 1965)

95 The incorporation in vitro of l-valine into the fat-body protein of the larva of the blowfly, Calliphora erythrocephala. (Price, G. M., 1965)

101 Free amino acids of the virginia pine sawfly, Neodiprion pratti Dyar: their chromatographic determination and biosynthesis. (Schaefer, C. H., 1964)

5. Neutron Activation Analysis

1039(2) Guinn, V. P., Schmitt, R. A. DETERMINATION OF PESTICIDE RESIDUES BY NEUTRON-ACTIVATION ANALYSIS. Residue Rev. 5 (1963) 148-74.

Samples and standards were activated at the same flux, time, and counting conditions to detect the following pesticide residues: Br from nematocides at 10^8 neutrons/cm^2 sec from a Van de Graaff accelerator and γ-ray detection of 18 min ^{80}Br; also from a TRIGA reactor, a flux of 10^{12} neutrons/cm^2 sec to determine 1 ppm Br with sensitivities of 0.005 γ ^{80}Br and 0.01 γ ^{82}Br; detection of 0.1 γ ^{38}Cl; ^{197}Hg down to 0.1 ppm and with radiochemical separation sensitivities to 0.001 ppm were possible. Various neutron sources and radiation-detection instruments were described in detail. (CA 61 : 1964, 11239h)

1040(2) Riebartsch, K. INAKTIVE MARKIERUNG VON INSEKTEN MIT DYSPROSIUM. (Inactive labelling of insects with dysprosium). NachrBl. dt. PflSchutzdienst, Stuttg. 15, 10 (1963) 154-7. (In German)

Insects can be labelled with inactive dysprosium, which is subsequently rendered radioactive in a nuclear reactor and measured in a scintillation counter. The procedure has all the advantages of conventional radiotracer techniques without the danger of contaminating the experimental environment with radioactivity and the necessity of restricting the duration of the experiment because of the short half-life of most of the conventional radiotracers so far used. Activation and measurement can take place at any time after labelling. The rareness of dysprosium ensures that the insects contain none except that administered to them, and the period required for activation is so short that other insect elements are not significantly affected and chemical recovery of the dysprosium before measurement is unnecessary. The half-life of radioactive dysprosium (^{165}Dy) is 2.32 h, so that measurement can be carried out several hours after activation and, since only about a millionth of the original activity persists after 48 h, the whole process repeated if necessary after 2 d. An account is given of investigations carried out to develop an acceptable labelling technique. Adults of Ceratitis capitata (Wied.) were fed on solutions of dysprosium chloride, the preparation of which from the commercial oxide is described; 0.1% solutions caused little harm to them, but 1% solutions proved toxic, the insects dying within 3 d. A 0.02% dysprosium concentration was therefore selected. In one experiment, the insects were allowed to feed on the solution of 24 h and then received a normal diet during the next 10 d. Every 3rd day during this period, insects were removed for activation. In another, the insects received the solution for 10 d, at the end of which they were dissected and the various parts, and also the eggs laid by the females, investigated for their dysprosium content. Quantities of dysprosium amounting to 10^{-8} g were determinable with a margin of error of about 5%. At 10^{-6} g, the margin was about 1.3%. During 24 h of feeding, about 10^{-6} g dysprosium was ingested per individual, and about 5% of that amount was still present after a further 10 d. Feeding for up to 10 d resulted in no greater content of dysprosium in the flies than was present after 1 d, and there was no difference in dysprosium content between males and females or between individuals that were washed with hydrochloric acid to eliminate external traces of dysprosium and those that were not. The content of dysprosium amounted to 0.83×10^{-6} g in the abdomen, 0.16×10^{-6} g in the head, 0.03×10^{-6} g in the legs and 0.003×10^{-6} g in the wings. The amount in the eggs was between 0.02×10^{-6} and 0.15×10^{-6} g. (Essentially RAE-A 53:1965, 381)

See also:

243 The estimation of adenosine triphosphate and related compounds in insect tissue. (Heslop, J. P., 1964)

6. Miscellaneous (including Radiography)

1041(1) Battelle Memorial Inst., Columbus, Ohio. THE DEVELOPMENT OF A GAMMA RADIOGRAPHIC METHOD FOR THE UNDERWATER INSPECTION OF MARINE PILING. Summary Report, 15 Apr. 1956.

Thulium-170 is used for the underwater inspection of 3.5 in.-thick waterlogged marine piling. The damaging effects of infestion with marine borers can thus be detected in time for replacement.

1042(2) Carvalho, J. P. de. CONTRIBUTION OF THE RADIOGRAPHIC METHOD FOR THE STUDY OF Sitotroga cerealella (Oliv.). Agricultura, Lis. 19 (1963) 22-25. (In Portuguese)

1043 Deleted

1044 Guptavanij, P., Venard, C. E. A RADIOGRAPHIC STUDY OF THE OESOPHAGEAL DIVERTICULA AND STOMACH OF Aedes aegypti (L.). Mosquito News 25, 3 (1965) 288-93.

The study was undertaken to determine the location of a meal and to observe the shape and position of the organs containing it. Foods used were glucose solution, citrated rabbit blood, heparinized fresh rabbit blood, and direct blood meals from mice. Various contrast media were used, the most suitable being Hypaque (sodium 3, 5-diacetamido-2, 4, 6-triiodobenzoate), at 0.60 g/ml. An industrial x-ray unit (150 kV tube with Be-window and a focal spot of 0.7 and 2.5 mm) was employed. The shape, size, and positions of the diverticula became clearly visible. Two similar diverticula are located dorsal to the oesophagus which occupy 1/3-1/2 of the anterior portion of the thorax dorsal to the alimentary canal. The diverticula are separated at the midline by longitudinal flight muscles. The ventral diverticulum varies tremendously in size depending on the quantity inside it. The oesophagus puts the three diverticula in communication with each other in such a way that portions of their content can freely pass from one diverticulum to another by way of the common chamber formed by the oesophagus. After a blood meal the stomach (a narrow tube along most of its length) fills first from the posterior end. The ventral diverticulum is forced forward, forming a chamber of air under pressure anterior to the stomach. The duct, the oesophagus, and the dorsal diverticula all become inflated.

1045 Kirkpatrick, R. L., Wilbur, R. A. THE DEVELOPMENT AND HABITS OF THE GRANARY WEEVIL Sitophilus granarius WITHIN THE KERNEL OF WHEAT. J. econ. Ent. 58, 5 (1965) 979-85.

Radiographs were made with a General Electric x-ray Grain Inspection Unit using 20 kV and 5 mA and a 2½ min exposure to Type M Industrial film (Eastman Kodak Co. 1960). Radiographs of wheat infested by granary weevil, S. granarius (L.), were made daily from egg to emerged adult. Enlarged prints of the radiographs were mounted consecutively on illustration boards to facilitate study of development and habits of the weevils within kernels. Measurements of tunnel widths were used to determine instars. A series of four increases in tunnel width occurred, each of which was followed by one or more days of static tunnel width. Each period of increased width paralleled feeding activity; the static width formulated the following instar.

1046(2) Lal, H., Ginocchio, S., Hawrylewicz, E. J. PROCEDURE FOR BIOASSAYING MOSQUITO REPELLENTS IN LABORATORY ANIMALS. Proc. Soc. exp. Biol. Med. 113 (1963) 770-2.

Mice were injected intravenously with 0.005 ml/g of mouse weight of an indicator solution containing 20 mg of Blancophore (SVT-400, General Dyestuff Co., N. Y.) dye and 20 µCi of ^{131}I-serum albumin. Mosquitoes were admitted for 30 min. They were subsequently radioassayed and also counted under ultraviolet, when insects which had fed on mice appeared bright green while the others remained black. The prospective repellent was administered to the mouse at a predetermined time prior to testing. In the experiments on Aedes aegypti N, N-diethyl toluamide, Indalone, N, N-propylacetanilide, ronnel and thiamine hydrochloride were tested. The procedure is successful for testing the effects of repellents on living mice, because of uniform mixing of the radio-iodinated serum albumin within a very short period and because it remains restricted to the vascular compartments. The technique can also be used with other small lab animals. Experiments with urea-^{14}C did not give reproducible results.

1047 Levenbook, L., Dinamarca, M. L. A SIMPLIFIED IONIZATION CHAMBER PROCEDURE FOR THE CONTINUOUS MEASUREMENT OF RESPIRATORY C^{14}O$_2$ OF INSECTS. Analyt. Biochem. 11, 2 (1965) 391-4.

A vibrating-reed electrometer for continuously measuring the ^{14}CO$_2$ expired by insects which had been injected with radioactive glucose has been described (see Robinson and Chefurka: 1048). A simplified and improved procedure is proposed here, in which the experimental insect or other small animal injected with an oxidizable ^{14}C-tracer is placed directly in the ionization chamber. Living Phormia regina Meig. behaved very differently from dead insects with respect to ionization in the chamber. Alanine-U-^{14}C was very rapidly ionized to ^{14}CO$_2$, lysine-U-^{14}C very slowly. For small insects weighing ~ 100 mg (or less) the Cary-Tolbert chamber requires no modification.

1048 Robinson, J.R., Chefurka, W. CONTINUOUS MEASUREMENT OF $C^{14}O_2$ RESPIRED BY INSECTS. AN IONIZATION CHAMBER METHOD. Analyt. Biochem. 9 (1964) 197-203.

Details of a method and apparatus for continuous assay and recording of $^{14}CO_2$ respired by insects treated with ^{14}C-labelled materials are described. The technique, based upon an ionization flow chamber and vibrating-reed electrometer, is sensitive to less than 10^{-8} μCi of ^{14}C as $^{14}CO_2$ in the system and allows very economical use of labelled materials in the study of normal and poisoned metabolic pathways in vivo. (Auth.)

1049 Porter, N.S., Sheen, E.M. AN AUTOMATIC ENTOMOLOGICAL SPECIES COUNTER. p.5.22-4 of "Hanford Radiological Sciences Research and Development Annual Report for 1963". Gamertsfelder, C.C., Green, J.K., Eds. HW-81746, General Electric Co. Hanford Atomic Products Operation, Richland Wash. Jan. 1964.

During the study of radiation effects on entomological species such as the Tribolium castaneum and confusum, it is necessary periodically to count colony populations. By hand, such counts are tedious and time consuming; similarly, photographic methods require laborious techniques. An automatic counter for performing such tasks was developed. The instrument counts whole colonies of the species being investigated. (Auth.)

1050 Smith G.N., Ludwig, P.D., Wright, K.C., Bauriedel, W.R. SIMPLE APPARATUS FOR COMBUSTION OF SAMPLES CONTAINING ^{14}C-LABELED PESTICIDES FOR RESIDUE ANALYSIS. J. agric. Fd Chem. 12, 2 (1964) 172-5.

A simple apparatus is described for the combustion of biological samples containing ^{14}C-labelled pesticides. The apparatus can be used to trap the liberated radioactive CO_2 as $BaCO_3$ or in ethanolamine for scintillation counting. The apparatus is rapid, simple, safe to operate, and can be used with any type of biological sample. (Auth.)

See also:

530 Grasshopper neuroblast techniques. (Carlson, J.G., Gaulden, M.E., 1964)
765 The control of spontaneous locomotor activity in Phormia regina Meigen. - II. Experiments to determine the mechanism involved. (Green, G.W., 1964)
1017 Design of ^{90}Sr sources for ecological studies involving beta irradiation. (Menhinick, E.F., 1964)
1027 Some laboratory observations on the rates of development, mortality and oviposition of several species of Bruchidae breeding in stored pulses. (Howe, R.W., Currie, J.E., 1964)

B. BIBLIOGRAPHIES AND GENERAL SURVEYS

1. Bibliographies

1051 Binggeli, M.-H. RADIOISOTOPES AND IONIZING RADIATIONS IN ENTOMOLOGY (1961-1963). Bibliographical Series No. 15. STI/PUB/21/15, International Atomic Energy Agency, Vienna (Austria). 1965, 576p.

Fully annotated bibliography for the 3-year period 1961-1963, a follow-up of the first volume (Bibl. Series No. 9) which covered the 11-year period 1950-1960. Approximately 1600 references on radioisotopes and radiations in entomology from reports and articles in journals and books are given, complete with abstracts. Author, subject, and insecticide indexes are included. A special feature of the subject index is the citation, alongside each reference, of the relevant radioisotope or radiation employed in the study. Tabulated data are given on dispersal, sterilization, and insecticides (synthesis, metabolism, residues).

1052 International Atomic Energy Agency, Vienna (Austria). INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. No. 5. WP/31/5. Sep. 1964, 22p.

The circular is aimed at disseminating research information to workers in the field. This circular contains abstracts from seven papers presented at an agency panel on advances in insect population control by the sterile male technique, an ecological study, five studies each on ionizing radiation and on rearing techniques, and 17 on chemosterilants.

1053 International Atomic Energy Agency, Vienna (Austria). INFORMATION CIRCULAR ON RADIATION TECHNIQUES AND THEIR APPLICATION TO INSECT PESTS. No. 6. WP/31/6. June 1965, 14p.

The circular lists 7 ecological studies, 2 on the effects of ionizing radiation, 9 on rearing techniques, 4 on radiation sterilization theory, and 8 on chemosterilants.

1054(2) Franz, J.M., Laux, W. BIBLIOGRAPHIE ÜBER BIOLOGISCHE BEKÄMPFUNG. (Bibliography on biological control). Entomophaga 8, 4 (1963) 263-334.

Bibliographical listing without abstracts, in alphabetical order within a particular section. Section 9 deals with autocidal measures (p. 315-7): 43 references are cited, including work with chemosterilants. The following bibliographical lists have already appeared: Part I: Entomophaga, 1:1956, 107-112; II: ibid., 2:1957, 293-311; III: ibid., 3:1958, 333-364; IV: ibid., 4:1959, 315-348; V: ibid., 5:1960, 295-335; VI: ibid., 6:1961, 277-329; VII: ibid., 8:1963, 89-161.

1055 Franz, J.M., Laux, W. BIBLIOGRAPHIE ÜBER BIOLOGISCHE BEKÄMPFUNG. (Bibliography on biological control). Entomophaga 9, 4 (1964) 311-89.

Continuation of bibliography. Section 9 on autocidal measures (p. 376-80) contains 87 references, including chemosterilants, which represents a 50% increase over the preceding year.

1056 Klement, A.W., Jr., Schultz, V. TERRESTRIAL AND FRESHWATER RADIOECOLOGY. A Selected Bibliography – Supplement 2. TID-3910, Suppl. 2. March 1964, 123p.

This is the second supplement to the bibliography issued in March 1962, with a supplement in February 1963. References are taken from the open literature, listed alphabetically by first author. When obtained from NSA, the abstract number is given. No indexes are supplied. Numerous entomological studies are included.

1057 Scharffenberg, R.S., Pollard, J.K., Jr. CARBON-14. A COMPREHENSIVE ANNUAL BIBLIOGRAPHY OF APPLICATIONS IN CHEMISTRY, BIOLOGY AND MEDICINE. Jan. – Dec. 1963. Los Angeles, Calbiochem. 1964, 126p. Vol. 2.

2956 References are given to US and foreign publications on ^{14}C-tracer techniques in biology, chemistry, and medicine, published from 1962 through 1963. An index of ^{14}C-labelled compounds is included. A list of ^{14}C, deuterium, ^{35}S, tritium, and ^{15}N-labelled compounds available through Calbiochem is also included. Some work relevant to entomology is included.

1058 Ward, H.L. RADIOISOTOPES IN AGRICULTURE: ANALYTICAL PROCEDURES, ANIMAL HUSBANDRY, ENTOMOLOGY, FERTILIZER UPTAKE, GENERAL STUDIES, PHOTOSYNTHESIS, PLANT GENETICS, AND PLANT PHYSIOLOGY. A selected bibliography. TID-3078, Suppl. 1, Division of Technical Information Extension, AEC. May 1964, 24p.

A very general survey containing a total of 229 selected references are presented from literature published from 1958 - 1962 on uses of radioisotopes in agricultural sciences.

1059 Ward, H.L. INSECT CONTROL BY RADIATION AND RADIOISOTOPES. TID-3579, Technical Information Service Extension, AEC, Nov. 1964, 32p.

101 References selected from the scientific literature published since 1961 are presented. An insect index is included.

2. Surveys

1060 Brown, A.W.A. TACTICS OF INSECT CONTROL, PARTICULARLY IN MEDICAL ENTOMOLOGY. Can. Ent. 96, 1-2 (1964) 172-82.

Overall review of control measures against insect pests, especially mosquitoes. Resistance phenomena have been studied in numerous species. Countermeasures against resistance include the use of synergists, non-detoxicatable analogues, and negatively-correlated compounds. Resistance usually dictates a shift from the chlorinated hydrocarbon to the organophosphorus insecticides, thus reducing the residue problem, particularly for wildlife. Alternative methods of control include the sterile-male technique, with two successful examples (Callitroga hominivorax, Anastrepha ludens) but no success yet with mosquitoes, and the use of chemosterilants, with an example of imminent success against houseflies on islands. Chemosterilants however, like bacterial toxins, are not free from the possible development of resistance by detoxication.

1061 Chant, D. A. STRATEGY AND TACTICS OF INSECT CONTROL. Can. Ent. 96, 1-2 (1964) 182-201.

The background against which decisions on control strategy are made is explained and general approaches to pest control are discussed in detail. Canadian work on population dynamics that involves research on the processes regulating numbers is reviewed. Conventional and unconventional methods of control, including insect sterilization, are considered and the need for an adequate understanding of insect ecology is stressed.

1062 Cornwell, P. B. INSECT CONTROL. p. 141-98 of "Massive Radiation Techniques". Jefferson, S., Ed. London, George Newnes Ltd. 1964, 324p.

Comprehensive review article of research and applications of ionizing radiations for insect control. The effects of radiation on developmental stages of insects are considered, also reports on stimulating effects. Delayed growth and the production of deformities as well as modifications in mobility and feeding are among the effects involved. Radiation disinfestation of stored products is discussed together with its associated practical problems, and also insect control by sterile male release. 272 references.

1063$^{(2)}$ Day, M. F., Bailey, S. W., Norris, N. R. USES OF RADIOACTIVITY IN ENTOMOLOGY AND INSECT-PEST CONTROL. Aust. Mus. Mag. 13, 9 (1961) 291-3.

Survey.

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The uses of radioisotopes and radiation in agriculture are tabulated. The more important progress made in studies on soil, physiology and vegetable autoecology, radioactive precipitation, and entomology is summarized. (NSA 19:1965, 4554)

1067$^{(2)}$ Huque, H. ROLE OF ATOMIC ENERGY IN INSECT STUDY AND CONTROL. Agriculture Pakist. 13, 4 (1962) 77-80.

Brief, general survey of applications.

1068 Impens, R., François, E., Riga, A. L'UTILISATION DES RADIOISOTOPES ET DES RAYONNEMENTS EN ENTOMOLOGIE APPLIQUEE. Annls Gembloux 70 (1964) 45-63.

Review article. The advantages and limitations of the methods are described. 13 references (to 1963) are cited, including two IAEA Proceedings of Symposia.

1069 Ksiazek, J. ATOMIC ENERGY IN RADIATION DAMAGE TO LIVING ORGANISMS. Postepy Nauk roln. 12 (1965) 131-5. (In Polish).

The useful effects of sterilizing and pasteurizing doses of radiation are reviewed. Topics discussed include: the physical properties of ionizing radiation; radiation-dose damage; disinfection of grains, retardation of sprouting and germination of seed-type foods; sterilization of insects (males) and insect population control; changes in susceptability to disease due to induced mutations; and use of radioisotopes in biological research. (NSA 19:1965, 32631)

1070 Mercer, W. A., Ralls, J. W. USE OF ISOTOPES IN THE FOOD-CANNING INDUSTRY. Isotopes Radiat. Technol. 1, 3 (1964) 245-55.

Applications of isotopes in food processing research and quality control are reviewed. Applications discussed in detail include research on raw food and containers, quality control, autoradiography of crop samples treated with radioactive insecticides, research on food washing, and in the radiation processing of foods, with emphasis on the radio-sensitivity of spores of Clostridium botulinum (19 references). (NSA 18:1964, 22384)

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Invaluable as a condensed introduction to the impressive range of applications of radioisotopes and ionizing radiations in entomology. The book is planned to give an account of academic and utilitarian radiation studies on insects. Various uses of radioisotopes in entomology, both for labelling insects and for elucidating biochemical, physiological and toxicological mechanisms are considered. The book contains chapters on the non-genetic effects of radiation, tagging, insect control by irradiation, biochemistry, physiology, insects and light, organophosphorus insecticides, chlorinated hydrocarbons, and miscellaneous other insecticides. Author and subject indexes are supplied.

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1074$^{(2)}$ Taimr, L., Dlabola, J. UTILIZATION OF RADIOACTIVE TRACERS IN AGRICULTURAL ENTOMOLOGY. Za vys. Úrodu 11, 2 (1963) 471-. (In Czech)

III

TABLES AND INDEXES

TABLE 1

SYSTEMATIC LISTING OF INSECTS AND RELATED ARTHROPODS

Table 1

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
ARACHNIDA											
	Araneida		Ar		spiders	305, 311					
		Agelenidae	Ar. 1		funnel-web weavers						
				Agelena		227					+
				Tegenaria		227					+
		Argiopidae	Ar. 1a								
				Araneus diadematus Cl.		88					+
				Araneus sericatus		89, 90					+
		Epeiridae	Ar. 2		orb weavers						
				Epeira (Araneris)		227					+
		Theridiidae	Ar. 11		comb-footed spiders						
				Latrodectus tredecimguttatus		315					+
	Acarina		Ac		mites and ticks						
		Acaridae	Ac. 1		acarid mites						
				Acarus siro Linnaeus	grain mite	656, 1013	+				
		Dermanyssidae (?)	Ac. 4		dermanyssid mites						
				Echinolaelaps echidninus		255					
		Ixodidae	Ac. 8		hard-backed ticks						
				Boophilus		227		+			
				Dermacentor andersoni Stiles	Rocky Mountain wood tick	255			+		
				Hyalomma asiaticum		839			+		
		Tetranychidae	Ac. 14		spider mites						
				Tetranychus telarius (L.)	two-spotted	766	+				
				Tetranychus urticae (Koch)	spider mite	98, 284, 410-1	+				
		Tyroglyphidae	Ac. 16a	Tyroglyphus farinae		877	+				

AF = Insects of agricultural of forestry importance
V = Insects of veterinary interest
P = Pests of public health or household significance
B = Beneficial insects
E = Insects chosen for experimental purposes.

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA											
	Ephemeroptera		E		mayflies						
		Baetidae	E.1								
				Cloëon dipterum L.		34					+
	Odonata		F		damselflies and dragonflies						
		Aeschnidae	F.1								
				Aeschna grandis L.		34					+
				Aeschna mixta (Latr.)		249					+
		Agrionidae	F.2								
				Pyrrhosoma nymphula (Sulz.)		249					+
		Calopterygidae	F.2a								
				Calopteryx splendens Haar		513					+
				Calopteryx virgo (L.)		249					+
		Cordulegastridae	F.4								
				Cordulegaster boltonii (Donov.)		249					+
		Lestidae	F.7								
				Lestes sponsa Hans.		249					+
		Libellulidae	F.8								
				Leucorrhinia rubicunda L.		34					+
				Plathemis lydia		36					+
				Sympetrum vulgatum (L.)		249					+
	Orthoptera		H		cockroaches, grasshoppers and allies	521, 530					
		Acrididae	H.1		grasshoppers						
				Chorthippus brunneus		129	+				
				Chortophaga viridifasciata (DeG.)	green-striped grasshopper	57, 134-5, 169, 170, 520, 540-1, 552	+				

Table 1 (cont.)

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Orthoptera	Acrididae		Cyrtacanthacris tartarica		129	+				
				Locusta migratoria		60, 73, 220, 535, 795, 984	+				
				Melanoplus differentialis (Thos.)	differential grasshopper	59, 143-4, 148, 181, 186, 192, 263, 567	+				
				Podisma sapporense		754	+				
				Romalea microptera (P. de B.)	eastern lubber grasshopper	177, 251	+				
				Schistocerca gregaria Forsk.	desert locust	50, 70, 75, 102, 124, 129, 244-5, 818	+				
				Schistocerca vaga		59	+				
		Blattidae	II.2		cockroaches						
				Blaberus craniifer		796-8	+				+
				Blaberus giganteus		790	+				+
				Blattella germanica (L.)	German cockroach	69, 83-4, 193, 195, 321, 241-b, 350, 408, 445, 457-8, 500, 860			+		
				Eurycotis floridana		136, 190, 193-6			+		
				Leucophaea maderae (F.)	Madeira roach	224			+		
				Nauphoeta cinerea		809			+		
				Parcoblatta spp.	wood cockroach	41, 858			+		
				Periplaneta americana (L.)	American cockroach	49, 186, 201, 218, 221-2, 235, 253-4, 258, 269, 356, 398, 417, 434, 454, 457-8, 788, 850			+		
		Gryllidae	II.4		crickets	935					
				Acheta domesticus (L.)	European brown or home cricket	417, 777, 858-9, 860	+				
				Gryllus bimaculatus		37	+				
				Gryllus domesticus L.	domestic cricket	802, 850	+				
				Oecanthus domesticus	green cricket	311	+				
		Phasmatidae	II.7		walkingsticks						
				Carausius morosus Br.	stick insect	252	+				
		Tettigoniidae	II.9		longhorn grasshoppers and katydids						
				Orchelimum		311	+				
	Isoptera		K		termites	1037					
		Rhinotermitidae	K.3								
				Reticulitermes flavipes (Kollar)	eastern subterranean termite	1037	+				

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Psocoptera		L		booklice and psocids						
		Psocidae	L.2		psocids						
				Psocoptera	bark louse	960	+				
	Anoplura		O		sucking lice						
		Pediculidae	O.4		human lice						
				Pediculus humanus humanus L.	body louse	40, 366			+		
	Hemiptera (Heteroptera)		Q		true bugs						
		Lygaeidae	Q.10		lygaeid bugs						
				Oncopeltus fasciatus (Dall.)	large milkweed bug	33, 118, 241, 417, 429, 434, 812, 820, 858					+
		Myridae	Q.11		plant bugs						
				Lygus hesperus		285	+				
				Orthotylus virescens (Douglas and Scott)		297	+				
				Trygonotylus fulgoris (Prokelisia)		311					
		Pentatomidae	Q.15		stink bugs						
				Eurygaster integriceps Put.	grain bug	1	+				
		Reduviidae	Q.18								
				Rhodnius prolixus (Stål)		91, 179, 639, 806					+
				Triatoma infestans		351, 368			+		
	Hemiptera (Homoptera)		QQ		aphids, leafhoppers, planthoppers, scale insects and allies	275					
		Aphididae	QQ.2		aphids or plant lice						
				Aphis fabae Scop.	bean aphid	33, 295, 319	+				
				Hyperomyzus staphyleae Koch		319	+				
				Myzocallis discolor Monell		957-8	+				
				Myzus persicae	green peach aphid	295, 319	+				
		Cercopidae	QQ.4		spittlebugs						
				Clastoptera proteus	dogwood spittlebug	916, 958	+				

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Hemiptera (Homoptera)	Chermidae	QQ. 5		bark-, gall-aphids and phylloxeras						
				Phylloxera		786	+				
		Cicadellidae	QQ. 6		leafhoppers						
				Caligypona pellucida F.		304	+				
				Dalbulus maidis	corn leafhopper	283	+				
				Javesella pellucida F.		292	+				
		(Jassidae)		Limotettix striola		561	+				
				Scaphytopius magdalensis		958	+				
		Pseudococcidae	QQ. 18		mealybugs						
				Planococcoides njalensis (Laing)		280	+				
				Planococcus citri (Risso)	citrus mealybug	592	+				
		Psyllidae	QQ. 19		jumping plantlice or psyllids						
				Psylla pyricola Foerst.	pear psylla	317	+				
	Mecoptera		S		scorpionflies						
		Panorpidae	S. 3		scorpionflies						
				Panorpa communis		96, 118, 162					+
	Trichoptera		T		caddisflies						
		Limnephilidae	T. 2								
				Glyphotaelius puntatolineatus Retz.		34					+
				Halesus interpunctatus Zett.		34					+
	Lepidoptera		U		butterflies, moths, skippers	740				+	+
		*	*		silkworms	64, 86, 151, 163, 176, 507, 509, 518, 542-3, 549, 550-1, 624, 652, 654-5, 681, 686, 699, 702-3, 719, 727-33, 755				+	+
		Arctiidae	U. 2		tiger moths and allies						
				Arctia caja		262					
				Rhyparia purpurata		262					

* Available information was not sufficient to permit the assignment of families.

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Lepidoptera	Bombycidae	U. 3		silkworm moths						
				Bombyx mori (L.)	silkworm	45, 51, 53, 80, 106-8, 111, 131-2, 136, 142, 153-4, 175, 215-7, 226, 237, 312-3, 518, 726, 754, 774-5, 817, 821, 844-5, 896, 936, 1033, 1036, II/320				+	+
		Crambidae	U. 8		grass moths						
				Chilo partellus (zonellus) Swinhoe	maize and jowar stalk borer	2	+				
				Chilo suppressalis (Wlk.)	Asiatic rice borer	136, 422, 428	+				
		Galleriidae	U. 12		wax moths						
				Galleria mellonella (L.)	greater wax moth	268-9	+				+
		Gelechiidae	U. 13		gelechid moths						
				Gnorimoschema operculella (Zell.)	potato tuberworm	635, 763-4, 794, 813	+				
				Pectinophora gossypiella (Saund.)	pink bollworm	649, 971, 995, 1026	+				
				Pectinophora malvella Hbst.	mallow moth	994-a	+				
				Sitotroga cerealella (Oliv.)	Angumois grain moth	830-2, 1013, 1042	+				
		Hesperiidae	U. 19		skippers						
				Calpodes ethlius (Stoll)	large canna leaf roller	236	+				
		Leucopteridae	U. 22a								
				Leucoptera coffeella Guer.	coffee leaf miner	1000	+				
		Lymantriidae	U. 25		tussock moths						
				Porthetria dispar (L.)	gypsy moth	816, 838	+				
		Noctuidae	U. 29		owlet moths and underwings						
				Agrotis orthogonia Morr.	pale western cutworm	281	+				
				Agrotis ypsilon (Rottemburg)		803	+				
				Chloridea obsoleta		659, 971	+				
				Hadena basilinea	grain moth	1	+				
				Heliothis virescens (F.)	tobacco budworm	283	+				

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Lepidoptera	Noctuidae		Heliothis zea (Boddie)	bollworm, corn earworm, tomato fruitworm	393, 401-2	+				
				Laphygma exigua		971	+				
				Laphygma frugiperda (J. E. Smith)	fall armyworm	348	+				
				Prodenia eridania (Cram.)	southern armyworm	93	+				
				Prodenia litura	cotton leaf worm	383, 386-7	+				
				Pseudaletia unipuncta (Haw.)		803	+				
				Trichoplusia ni (Hbn.)	cabbage looper	263	+				
		Nymphalidae	U. 31		brush-footed butterflies						
				Aglais urticae		262	+				+
				Araschnia levana		262					+
				Inachis io		262					+
		Olethreutidae	U. 33		olethreutid moth						
				Carpocapsa pomonella (L.)	codling moth	971, 998-9	+				
				Eucosma sonomana Kearfott	jackpine shoot borer	1028	+				
				Grapholita molesta (Busck)	oriental fruit moth	293	+				
				Petrova albicapitana Busck	pitch nodule borer	1028	+				
		Papilionidae	U. 34								
				Papilio demodocus		262	+				
		Phycitidae	U. 36								
				Cadra cautella (Wlk.)	almond moth	651, 1003	+				
				Ephestia (= Anagasta)		741-2	+				
				Ephestia cautella	almond moth	846	+				
				Ephestia elutella (Hbn.)	tobacco moth	1019	+				
				Ephestia kühniella Z.	Mediterranean flour moth	791, 959	+				
				Paramyelois transitella (Wlk.)	navel orangeworm	996	+				
		Psychidae	U. 39		bagworm moths						
				Thyridopteryx ephemeraeformis	evergreen bagworm	834	+				

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Lepidoptera	Pyralidae	U.41		pyralid moths						
				Corcyra cephalonica Stanton		633	+				
				Diatraea saccharalis (F.)		658					
				Ectomyelois ceratoniae (Zell.)	carob moth	9	+				
				Plodia interpunctella (Hbn.)	Indian meal-moth	651, 1013, 1019	+				
		Pyraustidae	U.42		pyraustid moths						
				Ostrinia nubilalis (Hbn.)	European corn borer	804, 971	+				
		Saturniidae	U.43		giant silkworm moths						
				Antheraea pernyi	oak silkworm	82, 113, 139	+				
				Antheraea polyphemus	polyphemus moth	150	+				+
				Attacus ricini		138, 142	+				
				Hyalophora cecropia (L.)	cecropia moth	46, 120, 171, 182, 186, 192, 198-9, 201	+				+
				Samia cynthia (Drury)	cynthia moth	120, 150, 234	+				+
				Samia ricini		137	+				
		Sphingidae	U.46		sphynx moths						
				Celerio euphorbiae		781	+				
				Protoparce* sexta (Johan.)	tobacco hornworm	218, 263, 356, 486	+				
		Tortricidae	U.49		leaf roller moths						
				Argyroploce leucotreta Meyr		647	+				
				Argyrotaenia velutinana (Wlk.)	red-banded leaf roller	356	+				
				Platynota stultana (Wlshm)	omnivorous leaf roller	871	+				
	Coleoptera		V								
		Anobiidae	V.1		deathwatch and drugstore beetles						
				Lasioderma serricorne (F.)	cigarette beetle	651, 1013	+				
		Bostrichidae	V.5		false powder-post beetles						
				Rhyzopertha dominica (F.)	lesser grain borer	1013	+				

* Approved generic name: Manduca

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Coleoptera	Bruchidae	V.7		seed beetles						
				Acanthoscelides obtectus (Say)	bean weevil	971	+				
				Callosobruchus maculatus (F.)	cowpea weevil	874	+				
				Callosobruchus rhodesianus		1027	+				
				Callosobruchus subinnotatus Pic		819	+				
		Cerambycidae	V.12	Oberea schaumii Lec.	long-horned beetles or roundheaded wood borers	1028					
		Chrysomelidae	V.13		leaf beetles						
				Chrysomela knabi Brown	willow leaf beetle	32, 33	+				
				Diabrotica virgifera Lec.	western corn rootworm	338	+				
				Galeruca tanaceti (L.)		264-5	+				
				Leptinotarsa decemlineata (Say)	Colorado (potato) beetle	3, 417, 971	+				
				Oulema melanopa (L.)	cereal leaf beetle	767, 924	+				
		Coccinellidae	V.16		lady beetles						
				Chilocorus bipostulatus L.		10					
				Epilachna philippinensis		760	+				
				Epilachna varivestis Muls.	Mexican bean beetle	748, 760	+				
				Prototheca zopfii		271					
		Cucujidae	V.18		cucujid or flat bark beetles						
				Oryzaephilus mercator (Fauvel)	merchant grain beetle	846, 1003	+				
				Oryzaephilus surinamensis (L.)	saw-toothed grain beetle	641, 872, 1019	+				
		Curculionidae	V.19		snout beetles or weevils						
				Anthonomus grandis Boh.	boll weevil	38, 48, 200, 204-7, 261, 345, 360, 363, 393-4, 401, 500, 823	+				
				Calandra granaria (L.)	granary weevil	668, 884-5, 971, 1009	+				
				Conotrachelus nenuphar	plum curculio	820	+				
				Cryptorrhynchus lapathi L.		5					
				Pissodes strobi (Peck)	white-pine weevil	1028	+				

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Coleoptera	Curculionidae		Sitophilus granarius (L.)	granary weevil	653, 872, 883-7, 899, 900, 971, 1001, 1009, 1014, 1045	+				
				Sitophilus oryzae (L.)	rice weevil	653, 760, 768, 1013	+				
				Sitophilus sasakii (Tak.)		768	+				
				Sitophilus zeamais Mots.	rice weevil	653, 768, 811	+				
				Sternochetus lapathi (L.)	poplar and willow weevil	1028	+				
				Sternochetus mangiferae (F.)	mango weevil	879, 1018	+				
		Dermestidae	V.20		dermestid beetles						
				Anthrenus flaviceps Lec. (vorax Waterh.)		825	+				
				Attagenus piceus (Oliv.)	black carpet beetle	1013	+				
				Trogoderma glabrum Hbst.		656, 1013					
		Dytiscidae	V.21		predaceous diving beetles	314					+
				Dytiscus marginalis		178					
		Elateridae	V.22		click beetles, wireworms						
				Conoderus vesperinus (F.)	tobacco wireworm	263	+				
		Nitidulidae	V.35		sap beetles						
				Meligethes aeneus F.		292	+				
		Scarabaeidae	V.41		scarabs						
				Amphimallon majalis (Raz.)	European chafer	820	+				
				Melolontha vulgaris F.	cockchafer	975, II/1270	+				
		Scolytidae	V.42		bark beetles						
				Dendroctonus brevicomis Lec.	western-, southwestern pine beetle	1023	+				
				Dendroctonus frontalis Zimm.	southern-, Arizona-, smaller Mexican pine beetle	1025	+				
				Ips confusus (Lec.)	California five-spined ips	840-1, 843, 958, 960	+				

Table 1 (cont.)

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Coleoptera	Tenebrionidae	V.46		darkling beetles						
				Ocnera hispida (Forsk.)		762					
				Pelecyphorus densicollis Horn		308					
				Pimelia		779					
				Pimelia angulata expiata (Peyer.)		762					
				Pimelia angulata lesnei (Peyer.)		762					
				Stenomorpha puncticollis Lec.		308					
				Tenebrio molitor L.	yellow mealworm	55, 63, 248, 256, 776, 778, 782-3, 858-9, 860	+				+
				Tenebroides mauritanicus (L.)		1019					
				Tribolium		901	+				+
				Tribolium castaneum Hbst	red flour beetle	512, 636, 653, 675-7, 760, 814, 888, 890-3, 913-4, 919-23, 929, 959, 1049	+				+
				Tribolium confusum Duv.	confused flour beetle	636, 653, 657, 673, 675-6, 769, 779, 846-7, 851, 872, 880-1, 890-3, 900, 902-4, 918, 922-3, 959, 1013, 1019, 1049	+				+
	Hymenoptera		W								
		Apidae	W.3		bumble, carpenter, honey, and stingless bees						
				Apis mellifera L.	honey bee	43-b, 211-2, 223, 282, 606, 873, 912				+	
				Apis mellifica		65, 240, 242				+	
		Braconidae	W.5		braconids						
				Habrobracon juglandis		35, 533, 857, 959					+
				Habrobracon seriopae		35					+
				Macrocentrus ancylivorus Roh.		763-4				+	
				Phanerotoma flavitestacea Fischer		11				+	
		Cephidae	W.6		stem sawflies						
				Cephus cinctus Nort.	wheat stem sawflies	79	+				
		Chalcididae	W.7		chalcids						
				Copidosoma koehleri Blanch.		763-4				+	
		(Pteromalidae?)		Mormoniella		613, 712				+	
				Mormoniella vitripennis (Wlk.)		619, 628-9, 815				+	

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Hymenoptera	Cynipidae	W. 11		cynipids or gall wasps						
				Dryocosmus kuriphilus Yasumatsu	chestnut gall wasp	335	+				
		Diprionidae	W. 12		conifer sawflies						
				Neodiprion fulviceps		840-3	+				
				Neodiprion pratti Roh.	Virginia pine sawfly	101, 202, 213-4	+				
		Formicidae	W. 14		ants						
				Acanthomyops claviger Roger	smaller yellow ant	71	+				
				Camponotus castaneus Latr.	carpenter ants	894	+				
				Camponotus herculeanus L.		287-9	+				
				Camponotus ligniperda Latr.		287, 289	+				
				Crematogaster		311	+				
				Dorymyrmex	common ant	311					
				Formica integra		906, 958	+				
				Formica polyctena		277, 287	+				
				Lasius umbratus (Nyl.)		894	+				
				Pogonomyrmex occidentalis (Cress)		894	+				
				Tetramorium caespitum (L.)		894	+				
		Siricidae	W. 23		horntails						
				Sirex longicauda Middlk.		1030	+				
		Sphecidae	W. 24		cicada killers, mud-daubers, and sand wasps						
				Dahlbominus		504					+
				Dahlbominus fuliginosus		590					+
				Dahlbominus fuscipennis (Zett.)		591, 805, 835, 925					+
				Sceliphron cementarium	mud-dauber wasp	309, 310					+
				Trypoxylon politum	mud-dauber wasp	309, 310					+
		Trichogrammatidae	W. 28		minute egg parasites						
				Trichogramma semifumatum (Perkins)		303, 763				+	

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Hymenoptera	Vespidae	W.29		hornets, yellow jackets, and potter wasps						
				Paravespula germanica		290					+
				Paravespula vulgaris		290-1					+
	Diptera		X		flies						
		Calliphoridae	X.5		blowflies	272					
				Calliphora erythrocephala (Meig.)	blowfly	54, 72, 74, 76-8, 94-5, 103-5, 116, 118, 159, 172-4, 209, 238-9, 247, 643, 800		+			
				Callitroga hominivorax (Coq.)	screw-worm fly	642, 905, 1060		+			
				Cochliomyia hominivorax (Coq.)		495, 905, 967, 974, 981-3, 992		+			
				Lucilia	blowfly	632		+	+		
				Lucilia cuprina	blowfly	68		+			
				Lucilia sericata	sheep maggot fly	390, 979		+			
				Phaenicia cuprina	blowfly	752		+			
				Phaenicia sericata	sheep maggot fly	270		+			
				Phormia regina	black blowfly	136, 189, 208, 219, 266, 765		+			
				Protophormia terrae-novae (Rob.-Desv.)	northern blowfly, carrion fly	361, 771, 827-8			+		
		Chironomidae	X.9			56, 74, 123, 306			+		
				Acricotopus lucidus		229			+		
				Chironomus tentans		61, 114, 122, 158, 930, 940, 950, 954-5			+		
				Chironomus thummi		167, 180, 519, 750			+		
				Culicoides barbosi Wirth & Blanton		6			+		
				Culicoides furens Poey		6			+		
				Smittia		119, 233			+		
				Smittia parthenogenetica		130			+		
		Chloropidae	X.10		chloropid flies						
				Hippelates pusio Loew	eye gnat	637, 854			+		
		Culicidae	X.11		mosquitoes						
				Aedes aegypti (L.)	yellow fever mosquito	13, 25, 42, 99, 276, 279, 286, 337, 349, 372, 377, 498, 557, 927-8, 949, 971, 1044, 1046			+		
				Aedes atropalpus (Coq.)		314			+		

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Diptera	Culicidae	X.11	Aedes cataphylla Dyar		145			+		
				Aedes nigromaculis (Ludlow)		424			+		
				Anopheles albimanus		464			+		
				Anopheles atroparvus		506, 638			+		
				Anopheles punctipennis (Say)		314			+		
				Anopheles quadrimaculatus Say	common malaria mosquito	286, 498, 630, 756, 907, 971			+		
				Anopheles sergenti		273-4			+		
				Anopheles stephensi		299, 318			+		
				Culex pipiens fatigans Wied.		362, 630, 971			+		
				Culex pipiens quinquefasciatus Say	southern house mosquito	294, 464, 630			+		
				Culex quinquefasciatus Say		343			+		
				Culex restuans Theob.		314			+		
				Culex tarsalis		362, 373			+		
				Culex territans Wlk.		314			+		
		Cuterebridae	X.12		rabbit bots, rodent bots						
				Dermatobia hominis	human bot fly	988			+		
		Drosophilidae	X.14								
				Drosophila		15, 22, 81, 118, 149, 165, 321, 505, 507, 511, 514, 519, 524, 526, 534, 545, 548, 553, 556, 564, 569, 575, 581-2, 584, 586, 589, 595, 598, 600, 611, 614, 645, 664, 670, 689, 696, 708, 712, 736, 738, 744, 755, 780, 878, 882, 908, 933, 945-6					+
				Drosophila buskii		97, 164, 166					+
				Drosophila hydei		112, 161, 230, 515					+
				Drosophila melanogaster		14,16,17,18,21,23,24,26,27,58,62,66-7,87, 92,97b,109,126-8, 140,146-7,152,160,225, 508-10,516-7,523,525,527-9,531-2,536-8, 544,546-7,554,556,558-9,560,562-3,565-6, 568,570-9,580-9,593-7,599,601-5,608-9, 610,612,616-8,620-3,625-7,631,640,660-3, 665-7,669,671-2,674,678-9,680,682-5, 687-8,690-5,697-8,700,704-7,709-18, 720-5,734-5,737,739,743,745-7,751,753, 757,761,773,779,784,787,789,822,833,848, 862,865,867-8,875-6,882,889,895,909,910, 911,915,917,926,931,934,938-9,941-4,947, 971					+

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Diptera	Drosophilidae	X.14	Drosophila pseudoobscura		866, 932, 937, 948					+
				Drosophila simulans		126, 598					+
				Drosophila subobscura		855					+
				Drosophila virilis		141, 810					+
				Drosophila willistoni		607, 615, 935					+
		Muscidae	X.19		house flies, stable flies, and allies						
				Haematobia irritans (L.)	horn fly	644, 971		+			
				Musca domestica L.	house fly	19, 47, 110, 116-8, 155, 168, 191, 197, 203, 210, 239, 243, 267, 278, 321, 329, 336-7, 344, 347, 350, 354, 358, 385, 396, 398, 409, 417, 423, 447, 454, 457-8, 460-5, 468, 496, 499, 500, 504, 756, 785, 792-3, 808, 836-7, 849, 852-3	+		+		+
				Stomoxys calcitrans (L.)	stable fly	321, 395, 460, 495, 500		+			
		Mycetophilidae	X.20		fungus gnats						
				Sciara coprophila Lint.	house plant gnat	121, 156, 231-2	+				
		Oestridae	X.21		bot and warble flies			+			
				Hypoderma lineatum (De Vill.)	common cattle grub	634		+			
		Otitidae	X.22		otitid flies						
				Euxesta notata (Wied.)	spotted root maggot	359	+				
		Psilidae	X.26								
				Psila rosae (F.)	carrot rust fly	646	+				
		Sarcophagidae	X.29		flesh flies			+			
				Sarcophaga bullata		85		+		+	
				Sarcophaga peregrina		863-4		+			
		Sciaridae	X.29a		fungus gnats						
				Rhynchosciara angelae		133, 156-7, 250, 522					+
		Simuliidae	X.30		black flies	301					
		Syrphidae	X.32		flower flies						
				Eristalis tenax (L.)	drone fly	34	+			+	

Table 1 (cont.)

Class	Order	Family	Systematic Code	Scientific Name	Common Name(s)	Reference No.	AF	V	P	B	E
INSECTA	Diptera	Tephritidae	X.35		fruit flies	650, 861, 1004					
				Anastrepha ludens (Loew)	Mexican fruit fly	807, 1060	+				
				Ceratitis capitata (Wied.)	Mediterranean fruit fly	12, 302, 749, 971, 976, 978, 980, 984-9, 990-1, 993, 997, 1035, 1040	+				
				Dacus cucurbitae Coq.	melon fly	749, 994	+				
				Dacus dorsalis Hendel	oriental fruit fly	749, 977, 1035	+				
				Dacus oleae (Gmel.)	olive fruit fly	824, 971, 984	+				
				Dacus tryoni	Queensland fruit fly	799	+				
				Rhagoletis cerasi	cherry fruit fly	296	+				
				Rhagoletis pomonella (Walsh)	apple maggot	8	+				
	Syphonaptera		Y		fleas						
		Pulicidae	Y.2		pulicid fleas						
				Xenopsylla cheopis (Rothsch.)	oriental rat flea	20			+		

TABLE 2

LETHAL RADIATION EFFECTS

Table 2

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [days]	Temperature [°C]	Radiation	Dose	Lethal dose (LD)/days	Ref. No.
Acarina	Tyroglyphidae	Ac 16a	Tyroglyphus farinae	e			γ	12 000 R	100	877
				a			γ	18 000 - 20 000 R	100/30, 40	
Orthoptera	Acrididae	H 1	Schistocerca gregaria (Forsk.) [desert locust]	e			γ	90 000 - 120 000 R	100	818
				ℓ (2-5) *			γ	2 500 - 7 000 R	100	
				a "young"			γ	15 000 - 120 000 R	100/4	
Lepidoptera	Tortricidae	U 49	Platynota stultana (Wlshm) [omnivorous leaf roller]	a ♀	0-1		γ	16 000 R	> 99 (e)	871
				a ♂	0-1		γ	32 000 R	> 99 (e)	
Coleoptera	Bostrichidae	V 5	Rhyzopertha dominica (F.) [lesser grain borer]	p, a		30	γ	7 000 rad	50/63	651
						30	γ	25 000 rad	99.9/63	
	Bruchidae	V 7	Callosobruchus maculatus (F.) [cowpea weevil]	e	3	27	γ	1 000 rad	50	874
					3	27	γ	3 000 rad	100	
				ℓ	14	27	γ	2 500 rad 6 000 rad	50 100	
				p	27	27	γ	5 000 rad > 10 000 < 20 000 rad	50 100	
				a	0-1	27	γ	100 000 rad 176 000 rad	50/2 100/2	
	Cucujidae	V 18	Oryzaephilus surinamensis (L.) [saw-toothed grain beetle]	e	1-2	30	γ	9 600 rad	99.9/21	641
				ℓ	10-11	30	γ	8 600 rad	99.9/21	
				P early	20-21	30	γ	14 500 rad	99.9/21	
				P late	22-23	30	γ	30 800 rad	99.9/21	
				a	0-14	30	γ	20 600 rad	99, 21	
	Curculionidae	V 19	Sitophilus granarius (L.) [granary weevil]	e	0-6	26	γ	4 000 rep	100/28(a)	811
				ℓ	6-26	26	γ			
				p	26-32	26	γ	11 200 rep		
				a	32-36	26	γ			

* Instar may be indicated in parentheses.

Table 2 (cont.)

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [days]	Temperature [°C]	Radiation	Dose	Lethal dose (LD)/days	Ref. No.
Coleoptera	Curculionidae	V 19	Sitophilus granarius (L.) [granary weevil]	e	0- 4	26	γ	4 000 rep	99.9/60	1014
				ℓ	7-11	26	γ			
				p	28-32	26	γ	9 000 rep		
				a	7-11	26	γ			
				e, ℓ, a			γ	5 000 rad	100	1009
				a		26-31	γ	10 700 rad	99.9/56	883
					0- 1	15	γ	15 300 - 20 500 rad	100/56	899
						30	γ		100/14	
					21	24-25	γ	12 000 rad	100/210	1001
					21	24-25	γ	16 000 rad	100/21	
				a (6 strains)	9-14	26	γ	5 000 - 7 500 rad	50/21	653
				a (6 strains)	9-14	26	γ	7 800-14 500 rad	99.9/21	
				a			x	8 000 R	100/50	884
							x (hypoxia)	14 000 R	100/50	
			Sitophilus oryzae (L.) [rice weevil]	a (7 strains)	7-11	26	γ	5 000 - 5 500 rad	50/16	653
				a (7 strains)	7-11	26	γ	7400 - 8 300 rad	99.9/16	
			Sitophilus zeamais Mots.	a (3 strains)	7-11	26	γ	3 700 - 4 300 rad	50/21	653
				a (3 strains)	7-11	26	γ	6 600 - 13 700 rad	99.9/21	
				e	0- 5	26	γ	4 000 rep	100/21 (a)	811
				ℓ	5-20	26	γ			
				p	22-24	26	γ	11 200 rep		
				a	28-29	26	γ			
			Sternochetus mangiferae (F.) [mango weevil]	a			γ	30 000 - 60 000 rad	100	879
				immature			γ	> 75 000 rad	100/14	1018
	Scolytidae	V 42	Ips confusus (Lec.)	a♂			γ	7 500 R	50/11.5	843
	Tenebrionidae	V 46	Tribolium castaneum Hbst. [red flour beetle]	a	4-11	26	γ	11 900 - 15 000 rad 21 200 - 34 500 rad	50/21 99.9/21	653

Table 2 (cont.)

Table 2 (cont.)

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [days]	Temperature [°C]	Radiation	Dose	Lethal dose (LD)/days	Ref. No.
Coleoptera	Tenebrionidae	V 46	Tribolium castaneum Hbst. [red flour beetle]	e	2-3	30	γ	10 900 rad	99.9/28	869
				ℓ	14-15	30	γ	10 500 rad	99.9/28	
				p	26-27	30	γ	25 800 rad	99.9/28	
				a	0-14	30	γ	21 500 rad	99.9/28	
			Tribolium confusum Duv. [confused flour beetle]	a (4 strains)	4-11	26	γ	8 350 - 10 800 rad 12 300 - 22 200 rad	50/24 99.9/24	653
				e	2- 3	30	γ	4400 rad	99.9/28	869
				ℓ	14-15	30	γ	5200 rad	99.9/28	
				p	30-31	30	γ	14 500 rad	99.9/28	
				a	0-14	30	γ	12 800 rad	99.9/28	869
				a	random	27	γ	30 000 - 60 000 rad	100/30	881
Diptera	Chloropidae	X 10	Hippelates pusio Loew [eye gnat]	p	2 d pre-emergence	21	γ	15 000 R	50	854
				a♀	2-3	24	γ	>15 000 R	100/54	
				a♂			γ		100/41	
				a♀			γ	75 000 R	100/8	
				a♂			γ		100/7	
				a			γ	135 000 R	100/3	
	Drosophilidae	X 14	Drosophila melanogaster (Meig.)	a♀	1	25	x	96 000 R	50	862
				a♂	1	25	x	46 000 R	50	
	Tephritidae	X 35	Anastrepha ludens (Loew)	e	1	25	γ	2 000 R	99.9/7	807
				ℓ	10	26	γ	1 500 R	99.5 (a)	
				p	5-7		γ	25 000 R	100 (a)	
				a♀,♂	1		γ	50 000 R	50/21	
			Ceratitis capitata (Wied.) [Mediterranean fruit fly]	p	2-4	26	γ	5 000 - 15 000 R	100	971
				p	7	26	γ	70 000 R	100	

TABLE 3

STERILIZATION DATA

Table 3

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [h = hour(s) d = day(s)]	Temperature [°C]	Radiation	Dose	Sterility [%]	Ref. No.
Acarina	Acaridae	Ac 1	Acarus siro L. [grain mite]				γ	> 25 000 R		656
	Ixodidae	Ac 8	Hyalomma asiaticum	a♀			x	3 000 R	100	839
	Tetranychidae	Ac 14	Tetranychus telarius L. [two-spotted spider mite]	a♂		24	γ	> 32 000 R		766
				♀ deutonymph		24	γ	32 000 R	100	
Lepidoptera	Gelechiidae	U 13	Gnorimoschema operculella (Zell.) [potato tuberworm]	p♀	8 d		γ	18 000 rad	100	635
				p♂	8 d		γ	15 000 rad	100	
				p	5, 8 d	21	γ	24 000 R	100	813
				a	shortly after emergency		γ			
			Pectinophora gossypiella (Saund.) [pink boll worm]	p	1 d	30	γ	6 000 R	100	649
				p	3 d		γ	8 000 R	100	
				p	5 d		γ	22 000 R	100	
				p♀	7 d		γ	40 000 R	100	
				p♂	7 d		γ	55 000 R	100	
	Noctuidae	U 29	Chloridea obsoleta	p♂	post cocoon	23-25	γ	8 000 - 10 000 R		650
	Olethreutidae	U 33	Carpocapsa pomonella (L.) [codling moth]	p♂	mature		γ	40 000 rad	98	998
	Phycitidae	U 36	Paramyelois transitella (Wlk.) [navel orangeworm]	p♀, ♂	~8 d	28	γ	50 000 rad	"complete"	996
			Cadra cautella (Wlk.) [almond moth]	p, a	mostly pupae	26	γ	2 700 rad	50	651
				p, a			γ	23 500 rad	99	
	Tortricidae	U 49	Argyroploce leucotreta Meyr	e to a*)			γ	5 000 - 70 000 R (♀ more susceptible)		647
Coleoptera	Anobiidae	V 1	Lasioderma serricorne [cigarette beetle]	p, a		25	γ	10 000 rad	99, 9	651

*) Original not available

Table 3 (cont.)

Table 3 (cont.)

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [h = hour(s) d = day(s)]	Temperature [°C]	Radiation	Dose	Sterility [%]	Ref. No.
Coleoptera	Bostrichidae	V 5	Rhyzopertha dominica (F.) [lesser grain borer]	p + a	32-35 d 4-7 d	30	γ	2200 rad	50	651
				p+a			γ	11 000 rad	99.9	
				p+a			γ	16 000 rad	100	
	Bruchidae	V 7	Callosobruchus maculatus (F.) [cowpea weevil]	a ♀,♂	0-1 d		γ	10 000 rad	100	874
	Coccinellidae	V 16	Epilachna varivestis Muls. [Mexican bean beetle]	p♀	3 d		γ	1000 - 16 000 R	100	748
				p♂			γ	4000 - 16 000 R	100	
				a ♀,♂	2- 3 d		γ	8000 - 16 000 R	100	
	Cucujidae	V 18	Oryzaephilus surinamensis (L.) [saw-toothed grain beetle]	e	1- 2 d	30	γ	8000 rad	99.9	641
				ℓ	10-11 d		γ	6500 rad		
				P early	20-21 d		γ	7700 rad		
				P late	22-23 d		γ	12 000 rad		
				a	0-14 d		γ	15 300 rad		
	Curculionidae	V 19	Sitophilus granarius (L.) [granary weevil]	a (6 strains)	9-14 d	26	γ	~10 000 rad	99.9	653
				e	0- 3 d	26	γ	2000 rep	98	811
					3- 6d		γ	2000 rep	79	
				ℓ	6-10 d		γ	2800 rep	78	
					10-17 d		γ	2800 rep	84	
					17-26 d		γ	2800 rep	97	
							γ	4000 rep	lethal and/or sterilizing	
				p	26-32 d		γ	4000 rep	98	
				a	32-36 d		γ	4000 rep	97	
				a	21 d	25-28	γ	6000 rad	99.4	1001
							γ	16 000 rad	100	
			Sitophilus oryzae (L.) [rice weevil]	a (3 strains)	7-11 d	26	γ	7000 rad	99.9	653

Table 3 (cont.)

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [h = hour(s) d = day(s)]	Temperature [°C]	Radiation	Dose	Sterility [%]	Ref. No.
Coleoptera	Curculionidae	V 19	Sitophilus zeamais Mots.	a (3 strains)	7-11 d	26	γ	8000 rad	99,9	653
				e	0- 3 d	26	γ	1000 rep	99	811
							γ	1400 rep	100	
				e	3- 5 d		γ	1400 rep	71	
							γ	2000 rep	99	
				ℓ	5- 7 d		γ	2000 rep	95	
					9-13 d		γ	2000 rep	85	
					15-20 d		γ	2000 rep	98	
				p	22-24 d		γ	4000 rep	99,9	
				a	28-29 d		γ	2800 rep	97	
				a			γ	4000 rep	100	
			Sternochetus mangiferae (F.) [mango weevil]	a			γ	20 000 rad		1018
	Dermestidae	V 20	Anthonomus grandis Boh. [boll weevil]	a♂	12-36 h		γ	8000 R	100	823
			Trogoderma glabrum	a			γ	25 000 R	100	656
	Scolytidae	V 42	Ips confusus (Lec.)	a♀	newly emerged		γ	10 000 R	"almost complete"	843
				a♂			γ	7500 R	"almost complete"	
	Tenebrionidae	V 46	Tribolium castaneum Hbst. [red flour beetle]	a (5 strains)	4-11 d	26	γ	9500 rad	99,9	653
			Tribolium confusum Duv. [confused flour beetle]	a (4 strains)	4-11 d	26	γ	8000 rad	99,9	653
				a	30 d	27	γ	4000 rad	> 99,9	657
Diptera	Calliphoridae	X 5	Lucilia sericata [sheep maggot fly]	p♀			γ	⩾ 4500 rep	100 (?)	979
				p♂			γ	> 6000 rep	100 (?)	
	Chloropidae	X 10	Hippelates pusio Loew [eye gnat]	p♀	2 d before emergence	27	γ	4700 R		637
				p♂			γ	3750 R		
				p♀, p♂ *			γ	4500 R	*) partial recovery after 21 d	854

Table 3 (cont.)

Table 3 (cont.)

Order	Family	Systematic Code	Insect	Life Cycle Stage [e = egg ℓ = larva p = pupa a = adult]	Age [h = hour(s) d = day(s)]	Temperature [°C]	Radiation[a]	Dose	Sterility [%]	Ref. No.
Diptera	Chloropidae	X 10	Hippelates pusio Loew	a♀	24-36 h	27	γ	4900 R		637
				a♂			γ	4550 R		
				a♀, ♂			γ	5000 R	> 99	854
	Culicidae	X 11	Anopheles atroparvus				x	6000 R	100	638
			Anopheles quadrimaculatus Say [common malaria mosquito]	p	≥ 24 h	27	γ	10 000 - 12 000 R		756
				p♂	0-24 h		γ	12 000 R		907
	Muscidae	X 19	Haematobia irritans (L.) [horn fly]	p♀, ♂	10 d from e	27	γ	5 000 R	100	644
			Musca domestica L. [house fly]	p	31-54 h before eclosion	27	γ	2 850 R		756
	Oestridae	X 21	Hypoderma lineatum (de Vill.) [common cattle grub]	p♀		30-33	γ	2 500 R	100	634
				p♂		30-35	γ	5 000 R	100	
	Tephritidae	X 35	Ceratitis capitata [Mediterranean fruit fly]	p♀	2- 4 d	26	γ	≥ 5 000 R		971
				p	8	26	γ	8000 - 10 000 R		971, 980
			Dacus cucurbitae Coq. [melon fly]	p		field conditions	γ	9 500 R	100	994

TABLE 4

RADIOTRACER STUDIES ON INSECTICIDES 1, 2)

Data have been assembled in the following categories:

- B. BOTANICALS AND DERIVATIVES
- C. CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)
- D. DDT RELATIVES (diphenyl aliphatics)
- F. FUMIGANTS
- N. NICOTINE ALKALOIDS (including ANABASINE and related compounds)
- P. PHOSPHORUS-CONTAINING COMPOUNDS
    - A. ALIPHATIC DERIVATIVES
    - C. ARYL (PHENYL) DERIVATIVES
    - H. HETEROCYCLIC DERIVATIVES
- R. CHEMOSTERILANTS
- X. CARBAMATES
- Y. SYNERGISTS

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1) Chemical names and "other designations" for compounds cited in the bibliography have been compiled after consulting E. E. Kenaga's "Commercial and Experimental Organic Insecticides" (1963 Revision) in Bull. ent. Soc. Am. 9: 2, 1963, 67-103 and (1966 Revision) in 12: 2, 1966, 161-217. The chemical categories have been maintained, apart from slight modifications. Two indexes (i) Common and Manufacturers' Names Index, and (ii) Letter-and-Number Index (the latter differing somewhat from the separate Number and Letter Indexes of the article) have also been prepared.

2) The chemical name used in accordance with the principles of Chemical Abstracts nomenclature is generally marked with an asterisk, *.

	Chemical name	Other designations for chemical and its compositions	Synthesis**	Metabolism	Residue determination
	BOTANICALS AND DERIVATIVES				
B. 1	rotenone (from plant species Derris and Lonchocarpus)	rotenone powder and resins derris cubé	^{14}C (494)	rat liver ^{14}C (493)	
B. 2	* pyrethrum (principally from plant species Chrysanthemum cinariaefolium)	pyrethrum pyrethrin I pyrethrin II		Musca domestica ^{14}C (468, 501)	
B. 3	d-trans-chrysanthemumic acid		^{14}C (469)		
	CHLORINATED ARYL HYDROCARBONS (containing 6 or more chlorines)				
C. 1/2	benzene hexachloride * 1, 2, 3, 4, 5, 6-hexachlorocyclohexane, mixed isomers hexachlorocyclohexane 1, 2, 3, 4, 5, 6-hexachlorocyclohexane, 99% or more gamma isomer * lindane	BHC HCH 666 gammexane lindane gamma BHC	Analysis (technical sample) ^{36}Cl (334)	rat ^{14}C (331) ^{14}Cl (332, 333) plants (Castanea crenata) with insect galls ^{14}C (335)	

** If no other indication

C. 3	1, 2, 4, 5, 6, 7, 8, 8-octachloro-3a, 4, 7, 7a-tetrahydro-4, 7-methanoindane * chlordan 1, 2, 4, 5, 6, 7, 8, 8-octachloro-2, 3, 3a, 4, 7, 7a-hexahydro-4, 7-methanoindene 1, 2, 4, 5, 6, 7, 10, 10-octachloro-4, 7, 8, 9-tetrahydro-4, 7-endo-methyleneindane	chlordane Octa-Klor Octachlor Velsicol 1068 1068		rat ^{14}C (378)	
C. 4	not less than 95% of 1, 2, 3, 4, 10, 10-hexachloro-1, 4, 4a, 5, 8, 8a-hexahydro-1, 4-endo-exo-5, 8-dimethanonaphthalene * aldrin	aldrin compound 118 Octalene HHDN		Diabrotica virgifera ^{35}Cl (338) Musca domestica ^{14}C (337, 344) rat ^{14}C (341-a)	
C. 5	not less than 85% of 1, 2, 3, 4, 10, 10-hexachloro-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-endo-exo-5, 8-dimethanonaphthalene * dieldrin	dieldrin compound 497 Octalox HEOD		Anthonomus grandis ^{14}C (345, 360) Aedes aegypti ^{14}C (337) Culex pipiens quinquefasciatus ^{14}C (343) Blattella germanica ^{14}C (341-b) Diabrotica virgifera ^{36}Cl (338) Musca domestica ^{14}C (336, 337, 344) Mammals, toxicity to ^{14}C (339) mouse (pregnant) ^{14}C (353)	mouse (pregnant) ^{14}C (353)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				rabbit ^{14}C (341) rat, metab. and toxicity ^{36}Cl (340) ^{14}C (341) penetration ^{14}C (435) wheat, uptake from soil ^{14}C (342)	
C. 6	* 6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-methano-2, 4, 3-benzo-dioxathiepin 3-oxide	endosulfan Thiodan BIO-5462 Hoe 2671 Malix Niagara 5462		Musca domestica ^{14}C (346, 347)	
C. 7	* 1, 3, 4, 5, 6, 7, 8, 8-octachloro-3a, 4, 7, 7a-tetrahydro-4, 7-methanophthalan	Telodrin SD 4402 CP-14957		Aedes aegypti ^{14}C (349) Aspergillus niger ^{14}C (349) Aspergillus flavus ^{14}C (349) Penicillium chrysogenum ^{14}C (349) Penicillium notatum ^{14}C (349) Laphygma frugiperda ^{14}C (348)	
		DDT RELATIVES			
D. 1	dichloro diphenyl trichloroethane * 1, 1, 1-trichloro-2, 2-bis-(p-chlorophenyl) ethane	DDT Chlorophenothene		Aedes aegypti ^{14}C (372, 377) cockroach ^{14}C (370) Culex fatigans ^{14}C (362) Culex tarsalis ^{14}C (362) Anthonomus grandis ^{14}C (360, 363) Blattella germanica ^{14}C (350) Euxesta notata ^{14}C (359) Musca domestica ^{14}C (350, 354) ^{36}Cl (358) Pediculus humanus humanus ^{14}C (366) Protophormia terrae-novae ^{14}C (361) Stomoxys calcitrans ^{14}C (375) Triatoma infestans ^{14}C (351, 368) Escherichia coli ^{14}C (375) Serratia marcescens ^{14}C (375) cat ^{14}C (374)	fish ^{14}C (357) mouse (pregnant) ^{14}C (353) poultry ^{14}C (352) snails (Ampullaria) ^{14}C (357) lake water ^{14}C (367) mud ^{14}C (357) soil ^{14}C (357) vegetation ^{14}C (357)

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				cattle (bovine rumen fluid) ^{14}C (367) fish ^{14}C (357) mouse (pregnant) ^{14}C (353) rat (liver microsomes) ^{14}C (369) (skin) ^{14}C (435) snails (Ampullaria) ^{14}C (357) barley, susceptibility ^{14}C (376) porphyrins, reduced ^{14}C (367) marsh ecosystem ^{36}Cl (371)	
D.2	1, 1-bis(p-chlorophenyl)-2, 2-dichloroethane	TDE Rhothane® DDD		Argyrotaenia velutinana ^{14}C [illegible] Blattella germanica ^{14}C [illegible] Periplaneta americana ^{14}C [illegible] Protoparce sexta ^{14}C [illegible]	lake water ^{14}C [illegible]

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				Stomoxys calcitrans ^{14}C (375) man ^{14}C (355) rabbit ^{14}C (355) rat ^{14}C (369)	
D.3	1, 1-bis(p-chlorophenyl) 2, 2, 2-trichloroethanol *4, 4'-dichloro- α-(trichloromethyl) benzhydrol 1, 1, 1-trichloro-2-hydroxy-2, 2-bis(p-chlorophenyl) ethane	Kelthane® FW-293		Triatoma infestans ^{14}C (351)	
D.4	2-nitro-1, 1-bis(p-chlorophenyl) propane *1, 1-bis(p-chlorophenyl)-2-nitropropane	Prolan CS645A		Aedes aegypti ^{14}C (372)	
FUMIGANTS					
F.1	sulfuryl fluoride	Vikane		wheat (graham) flour ^{35}S (330)	
F.2	naphthalene			Musca domestica ^{14}C (329)	
F.3	hydrogen cyanide *hydrocyanic acid	HCN prussic acid (in H_2O)		basidiomycete (psychrophilic) ^{14}C (328)	
F.4	carbon tetrachloride	CCl_4		rat, liver ^{14}C (323-7)	

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
NICOTINE ALKALOIDS (including ANABASINE and RELATED COMPOUNDS)					
N. 1	*nicotine 1-1-methyl-2-(3-pyridyl)-pyrrolidine 1-3-(1-methyl-2-pyrrolidyl)-pyridine	Black Leaf (40) nicotine (sulfate)	^{14}C (470-2, 475-6, 482-4, 486, 492)	Conoderus vespertinus ^{14}C (263) Heliothis virescens ^{14}C (263) Melanoplus differentialis ^{14}C (263) Musca domestica ^{14}C (263) Protoparce sexta ^{14}C (263, 486) Trichoplusia ni ^{14}C (263) cat ^{14}C (472-3, 485) dog ^{14}C (485) mouse ^{14}C (472-3, 478-9) ^{3}H (474) rat ^{14}C (472, 478, 484) Nicotiana sp. ^{14}C (477, 483, 487, 490)	cat ^{14}C (473) mouse ^{14}C (473)

N. 2	tobacco alkaloids		^{14}C (480-1, 487, 489) ^{3}H (491)		Nicotiana sp. ^{14}C (488)
	anabasine		^{14}C (480-1, 489)	Nicotiana ^{14}C (487)	
	cotinine			mouse ^{3}H (474)	
	nornicotine			Nicotiana ^{14}C (487, 489) ^{3}H (491)	
PHOSPHORUS-CONTAINING COMPOUNDS PHOSPHORUS ALIPHATIC DERIVATIVES					
P/A. 1	*dimethyl (2, 2, 2-trichloro-1-hydroxyethyl) phosphonate	Dipterex Bayer L13/59 Dylox Neguvon chlorophos trichlorofon Tugon Dipteres	^{14}C (380) ^{32}P (384, 388) Analogues ^{32}P (388)	Musca domestica ^{32}P (385) Prodenia litura ^{14}C (383) ^{32}P (383, 386-7) Aspergillus niger ^{32}P (389) Fusarium spp. ^{32}P (389) Penicillium notatum ^{32}P (389) cattle ^{32}P (II/674) rat ^{14}C (380) ^{32}P (381-2)	

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				cotton ^{32}P (384)	
P/A. 2	O, O-dimethyl 2, 2-dichlorovinyl phosphate * 2, 2-dichlorovinyl dimethyl phosphate	DDVP Herkol Vapona dichlorvos		Lucilia sericata ^{32}P (390) Oncopeltus fasciatus ^{14}C (429)	meat ^{32}P (390)
P/A. 3	3-hydroxy-N-methyl crotonamide dimethyl phosphate	Azodrin SD 9129		Musca domestica ^{14}C (398) ^{32}P (398) Periplaneta americana ^{14}C (398) ^{32}P (398) goat ^{14}C (398) ^{32}P (398) rat ^{32}P (391) beans ^{32}P (398) cotton ^{32}P (391-2)	cotton ^{32}P (392) soil ^{32}P (392)
P/A. 4	* 3-(dimethoxyphosphinyloxy)-N, N-dimethyl-cis-crotonamide 2-dimethylcarbamoyl-1-methylvinyl dimethyl phosphate dimethyl phosphate of 3-hydroxy N, N-dimethyl-cis-crotonamide	Bidrin SD 3562		Anthonomus grandis ^{14}C (393-4) ^{32}P (393) Heliothis zea ^{32}P (393) Musca domestica ^{14}C (396) Periplaneta americana (toxicity to adults) ^{32}P (398) goat ^{14}C (398) ^{32}P (398) rat ^{14}C (393) ^{32}P (393) bean ^{32}P (398) cotton ^{14}C (393) ^{32}P (393, 397)	milk ^{14}C (398) ^{32}P (398) soil ^{14}C (395-6)
P/A. 5	O, O-diethyl O (and S)-2-(ethylthio) ethyl phosphorothioates * mixture of O, O-diethyl S- (and O) 2-(ethylthio)ethyl phosphorothioates mixture of O, O-diethyl S-ethylmercaptoethyl thiophosphate and O, O-diethyl O-ethylmercaptoethyl thiophosphate a trialkyl thiophosphate	demeton Systox E-1059 Bayer 8173 mercaptophos	Hydrolysis and isomerization ^{32}P (399)		

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/A. 6	*O, O-diethyl S-ethylthiomethyl phosphorodithioate O, O-diethyl S-ethylmercaptomethyl dithiophosphate	phorate Thimet L 11/6 AC 3911			millet ^{35}S (400)
P/A. 7	*O, O-diethyl S-2-(ethylthio)-ethyl phosphorodithioate	Bayer 19639 Di-Syston Ekatine dithiodemeton		Anthonomus grandis ^{32}P (401) Heliothis zea ^{32}P (401-2) rat ^{32}P (401-2) cotton ^{32}P (401, 403)	
P/A. 8	*O, O-dimethyl dithiophosphate of diethyl mercaptosuccinate O, O-dimethyl S-(1, 2-dicarbethoxyethyl) dithiophosphate S-[1, 2-bis(ethoxycarbonyl)-ethyl] O, O-dimethyl phosphorodithioate O, O-dimethyl phosphorodithioate ester with diethyl mercaptosuccinate	malathion Malathon 4049		Blattella germanica ^{14}C (84, 408) Musca domestica ^{14}C (336, 409) ^{32}P (409) Tetranychus urticae ^{14}C (410-11) rat ^{14}C (379, 435) ^{32}S (379) forest fauna (watershed) ^{32}S (404, 407, 412)	gooseberries ^{32}P (405-6)
P/A. 9	O, O-dimethyl thiophosphate of diethyl mercaptosuccinate	malaoxon		Musca domestica ^{32}P (409)	
P/A. 10	O, O-dimethyl S (N-methylcarbamoylmethyl) phosphorodithioate *S-methylcarbamoylmethyl O, O-dimethyl phosphorodithioate O, O-dimethyl S-α-mercapto-N-methylacetamido dithiophosphate methyl dimethyl dithiophosphoryl acetamide	dimethoate Cygon Rogor AC 12880 ENT 24650 NC-262	Properties ^{32}P (419)	Acheta domesticus ^{3}H (417) Leptinotarsa decemlineata ^{3}H (417) Musca domestica ^{3}H (417) Oncopeltus fasciatus ^{3}H (417) Periplaneta americana ^{3}H (417) dog ^{32}P (416) man ^{32}P (415) mouse ^{32}P (416) ^{131}I (418) pig ^{32}P (416) poultry ^{32}P (416) rabbit ^{32}P (416) rat ^{32}P (416) sheep ^{32}P (416)	

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				cotton ^{32}P (413) lemon ^{32}P (414)	
	PHOSPHORUS PHENYL (CARBOCYCLIC) DERIVATIVES				
P/C. 1	*O, O-dimethyl O-p-nitrophenyl phosphorothioate O, O-dimethyl O-p-nitrophenyl thiophosphate dimethyl p-nitrophenyl thionophosphate dimethyl p-nitrophenyl phosphorothionate	methyl parathion methyl homologue of parathion Nitrox Bayer E-601 Metron		guinea pig ^{32}P (431) rat ^{131}I (420) ^{32}P(431)	
P/C. 2	O, O-diethyl O-p-nitrophenyl phosphorothioate *parathion O, O-diethyl O-p-nitrophenyl thiophosphate diethyl p-nitrophenyl thionophosphate diethyl p-nitrophenyl phosphorothionate	parathion Alkron Niran Thiophos Amer. Cyan. 3422 Bayer E-605	^{3}H (425-7) ^{32}P (423) labelling ^{3}H (322)	Aedes nigromaculis ^{32}P (424) Chilo suppressalis ^{32}P (422, 428) Musca domestica ^{32}P (423) Oncopeltus fasciatus ^{3}H (429) Tetranychus urticae ^{3}H (410-11) frog ^{3}H (427) guinea pig ^{3}H (427) mouse ^{3}H (427)	
				pig ^{3}H (427) pigeon ^{3}H (427) rat ^{3}H (427) ^{35}S (426) toad ^{3}H (427) trout ^{3}H (427) turtle ^{3}H (427) poplar ^{32}P (421)	
P/C. 3	O, O-diethyl O-p-nitrophenyl phosphate *diethyl p-nitrophenyl phosphate	paraoxon oxygen analogue of parathion Bayer E-600	^{32}P (423)	Musca domestica ^{32}P (423) cat ^{32}P (430)	
P/C. 4	4-nitrophenyl dimethyl phosphate			cotton ^{32}P (419)	
P/C. 5	O-phenyl O'-(4-nitrophenyl) methylphosphonothioate	Colep	^{14}C (430-a)	rat ^{14}C (430-a) apple ^{14}C (430-a) cotton ^{14}C (430-a)	

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/C. 6	O, O-dimethyl O-(3-chloro-4-nitrophenyl) thiophosphate * O-(3-chloro-4-nitrophenyl) O, O-dimethyl phosphorothioate	Chlorthion Bayer 22/190		rat ^{14}C (379) ^{35}S (379)	
P/C. 7	O, O-dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate * O, O-dimethyl O-(4-nitro-m-tolyl) phosphorothioate	Folithion Bayer 41831 Sumithion Sumitomo S-1102 A		guinea pig ^{32}P (431) rat ^{32}P (431)	
P/C. 8	4-methylthiophenyl dimethyl phosphate			cotton ^{32}P (419)	
P/C. 9	* O, O-dimethyl O-2, 4, 5-trichlorophenyl phosphorothioate	ronnel Dow ET-57 Dow ET-14 Korlan Nankor Trolene Etrolene Fenchlorphos		cattle ^{32}P (433) rat ^{32}P (433) sheep ^{32}P (433)	
P/C. 10	2, 4, 5-trichlorophenyl dimethyl phosphate			cotton ^{32}P (419)	
P/C. 11	O-p-methylthiophenyl O-methylmethylphosphonothioate			cotton (432)	

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/C. 12	O-p-(dimethylsulfamoyl) phenyl O, O-dimethyl phosphorothioate	famphur Warbex® Famophos CL 38023		Oncopeltus fasciatus ^{3}H (434) Periplaneta americana ^{3}H (434) mouse ^{3}H (434) rat ^{3}H (435)	
P/C. 13	ethyl ester of O, O-dimethyldithiophosphoryl α-phenyl acetic acid * ethyl (dimethoxyphosphinothioylthio) phenylacetate	Dimephenthoate Cidial			olive oil ^{32}P (436) oliye ^{32}P (437)
P/C. 14	alpha-methylbenzyl 3-hydroxy-crotonate dimethyl phosphate	Ciodrin® Shell SD-4294		sheep (ewe) ^{32}P (438) goat (lactating) ^{32}P (439)	milk ^{32}P (438-9)
P/C. 15	alpha-methylbenzyl 3-(dimethoxy-phosphinyloxy)-crotonate		^{14}C, ^{32}P (401)		
P/C. 16		1605	^{14}C (441)		
P/C. 17		Lurgo	^{14}C (441)		

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
	PHOSPHORUS HETEROCYCLIC DERIVATIVES				
P/H. 1	O, O-diethyl O-3-chloro-4-methyl-2-oxo-2H-1-benzopyran-7-yl phosphorothioate * O-(3-chloro-4-methylumbelliferone) O, O-diethyl phosphorothioate O, O-diethyl O-(3-chloro-4-methyl-7-coumarinyl) phosphorothioate 3-chloro-4-methylumbelliferone, O, O-diethyl thiophosphate	Bayer 21/199 CO-RAL Muscotox		cattle ^{32}P (460)	
P/H. 2	naphthaloximido-O, O-diethyl phosphorothioate * O, O-diethyl O-naphthalimido phosphorothioate	Bayer 22408 ENT 24970		cattle ^{32}P (460)	
P/H. 3	phthalimidomethyl O, O-dimethyl phosphorodithioate * O, O-dimethyl S-phthalimidomethyl phosphorodithioate	Imidan Prolate R-1504		Blattella germanica ^{14}C (445) insects ^{14}C (443) cattle ^{14}C (442) rat ^{14}C (443, 445) cotton ^{14}C (444)	

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
P/H. 4	O, O-diethyl O-3, 5, 6-trichloro-2-pyridyl phosphorothioate	Dursban	Properties ^{36}Cl (446)		^{36}Cl (446)
P/H. 5	O, O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidyl) thiophosphate * O, O-diethyl O-(2-isopropyl-6-methyl-4-pyrimidinyl) phosphorothioate	diazinon Basudin G-24480		Musca domestica ^{14}C (336, 447) ^{32}P (423)	^{14}C (448)
	CHEMOSTERILANTS				
R. 1	* tris(1-aziridinyl) phosphine oxide	tepa aphoxide ENT. 24915 APO		Musca domestica ^{14}C (496) rat ^{32}P (497)	
R. 2	* tris(1-aziridinyl) phosphine sulphide	thiotepa		Anthonomus grandis ^{32}P (500) Blattella germanica ^{32}P (500) Musca domestica ^{32}P (500) Stomoxys calcitrans ^{32}P (500) rat ^{32}P (500)	
R. 3	* tris[1-(2-methylaziridinyl)] phosphine oxide	metepa metaphoxide ENT. 50003 MAPO methyl aphoxide		Aedes aegypti ^{32}P (498) Anopheles quadrimaculatus ^{32}P (495)	

Table 4 (cont.)

Table 4 (cont.)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination
				Cochliomyia hominivorax ^{32}P (495) Musca domestica ^{32}P (498) Stomoxys calcitrans ^{32}P (495)	
R. 4	*5-fluoroacetic acid	fluoroorotic acid		Musca domestica ^{14}C (499)	
CARBAMATES					
X. 1	dimethyl 5-(1-isopropyl-3-methylpyrazolyl) carbamate *1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate	Isolan® G 23611		Musca domestica (463) (effect of insecticide on feeding, ^{14}C)	
X. 2	*o-isopropoxyphenylmethylcarbamate 2-isopropoxyphenyl methylcarbamate	Baygon® UNDEN® propoxur Bayer 9010 Bayer 39007		Anopheles albimanus ^{14}C (464) Culex pipiens quinquefasciatus ^{14}C (464) Musca domestica ^{14}C (454) Periplaneta americana ^{14}C (454) beans ^{14}C (459)	

Table 4 (cont.)

X. 3	4-methylthio) 3, 5-xylyl methylcarbamate	MESUROL® mercaptodimethur Bayer H-321 Bayer 9026 Bayer 37344 ENT-25726		beans ^{14}C (459)	
X. 4	4-dimethylamino-m-tolyl methylcarbamate	MATACIL® aminocarb arprocarb Bayer 44646 ENT-25784		beans ^{14}C (459)	
X. 5	4-dimethylamino-3, 5-xylyl methylcarbamate	Zectran® Dowco 139® ENT 25766	^{14}C (451)	Musca domestica ^{14}C (462, 465) dog ^{14}C (449, 450) beans ^{14}C (459) broccoli ^{14}C (452-3)	beans ^{14}C (459) broccoli ^{14}C (453)
X. 6	*1-naphthyl methylcarbamate 1-naphthyl N-methylcarbamate α-naphthyl N-methylcarbamate	carbaryl Sevin® 7744		Musca domestica ^{14}C (454, 501) Periplaneta americana ^{14}C (454) cattle (460) goat ^{14}C (454) guinea pig ^{14}C (455)	apple ^{14}C (456)

	Chemical name	Other designations for chemical and its compositions	Synthesis	Metabolism	Residue determination**
				man ^{14}C (455) rat ^{3}H (435) ^{14}C (455) apple ^{14}C (456) beans ^{14}C (454, 459) cotton ^{14}C (454)	
X. 7	*1-(dimethylcarbamoyl)- 5-methyl-3-pyrazolyl dimethylcarbamate 2-dimethylcarbamyl-3-methylpyrazolyl-(5)-dimethylcarbamate 2-dimethylcarbamoyl-3-methyl-5-pyrazolyl dimethylcarbamate	dimetilan Dimetilan ® Dimetilane GS-13332		Blattella germanica ^{14}C (457-8) Musca domestica ^{14}C (457-8) Periplaneta americana ^{14}C (457-8)	
X. 8	Various phenyl N-methylcarbamates		^{14}C (461)	beans ^{14}C (459, 461) Musca domestica ^{14}C (461-2, 465) rat ^{14}C (461, 467)	
	Y. SYNERGISTS				
Y. 1	*α-[2-(2-butoxyethoxy) ethoxy]- 4, 5-methylenedioxy-2-propyltoluene butylcarbitol-6-propylpiperonyl ether	piperonyl butoxide Butocide	^{14}C (501)		
Y. 2	4-allyl-1, 2-methylenedioxybenzene	safrole	^{14}C (501)		
Y. 3	4-propyl-1, 2-methylenedioxybenzene	dihydrosafrole	^{14}C (501)		
Y. 4	*1, 2-methylenedioxy-4-[2-(octylsulfinyl)propyl] benzene n-octyl sulphoxide of isosafrole	sulfoxide Sulfox-Cide	^{14}C (501)		
Y. 5	5-allyl-1-methoxy-2, 3-methylenedioxybenzene	myricistin	^{14}C (501)		
Y. 6	*isobornyl thiocyanoacetate (-82%, other related terpenes - 18%) terpinyl thiocyanoacetate mixture of fenchyl and isobornyl thiocyanoacetate	Thanite		Musca domestica ^{14}C (462)	

** Simple apparatus for residue analysis by combustion of samples containing ^{14}C-pesticides (1050)

INSECTICIDE INDEXES

COMMON AND MANUFACTURERS' NAMES INDEX

Insecticide	Category	Insecticide	Category
aldrin	C.4	malathion	P/A.8
Alkron	P/C.2	Malathion	P/A.8
aminocarb	X.4	Malix	C.6
aphoxide	R.1	Maracil ®	X.4
arpocarb	X.4	mercaptodimethur	X.3
Azodrin	P/A.3	mercaptophos	P/A.5
Basudin	P/H.5	Mesurol ®	X.3
Baygon ®	X.2	metaphoxide	R.3
Bidrin	P/A.4	metepa	R.3
Black Leaf (40)	N.1	methyl aphoxide	R.3
Butocide	Y.1	methyl parathion	P/C.1
carbaryl	X.6	Metron	P/C.1
chlordane	C.3	Muscotox	P/H.1
Chlorophenothene	D.1	myricistin	Y.5
chlorophos	P/A.1	Nankor	P/C.9
Chlorthion	P/C.6	Neguvon	P/A.1
d-trans-chrysanthemumic acid	B.3	nicotine (sulphate)	N.1
Cidial	P/C.13	Niran	P/C.2
Ciodrin ®	P/C.14	Octachlor	C.3
Colep	P/C.5	Octa-Klor	C.3
cubé	B.1	Octalene	C.4
Cygon	P/A.10	paraoxon	P/C.3
demeton	P/A.5	parathion	P/C.2
derris	B.1	phorate	P/A.6
diazinon	P/H.5	piperonyl butoxide	Y.1
dichlorvos	P/A.2	Prolan	D.4
dihydrosafrole	Y.3	Prolate	P/H.3
Dimephenthoate	P/C.13	propoxur	X.2
dimethoate	P/A.10	prussic acid	F.3
dimetilan	X.7	pyrethrin I	B.2
Dimetilan ®	X.7	pyrethrin II	B.2
Dimetilane	X.7	pyrethrum	B.2
Dipteres	P/A.1	Rhothane ®	D.2
Dipterex	P/A.1	Rogor	P/A.10
Di-Syston	P/A.7	rotenone	B.1
dithiodemeton	P/A.7	safrole	Y.2
Dursban	P/H.4	Sevin	X.6
Dylox	P/A.1	Sulfox-Cide	Y.4
Ekatine	P/A.7	sulfoxide	Y.4
endosulfan	C.6	Sumithion	P/C.7
Etrolene	P/C.9	Systox	P/A.5
Famophos	P/C.12	Telodrin	C.7
famphur	P/C.12	tepa	R.1
Fenchlorphos	P/C.9	Thanite	Y.6
fluoroorotic acid	R.4	Thimet	P/A.6
Folithion	P/C.7	Thiodan	C.6
gammexane	C.1/2	Thiophos	P/C.2
Herkol	P/A.2	thiotepa	R.2
hydrogen cyanide	F.3	trichlorfon	P/A.1
Imidan	P/H.3	Trolene	P/C.9
Isolan ®	X.1	Tugon	P/A.1
Kelthane ®	D.3	Unden ®	X.2
Korlan	P/C.9	Vapona	P/A.2
lindane	C.1/2	Vikane	F.1
Lurgo	P/C.17	Warbex ®	P/C.12
malaoxon	P/A.9	Zectran®	X.5

LETTER AND NUMBER INDEX

Letter/Number	Chemical classification code	Letter/Number	Chemical classification code
AC 3911	P/A.6	ENT 25784	X.4
AC 12880	P/A.10	ENT 50003	R.3
Amer. Cyan. 3422	P/C.2	FW-293	D.3
APO	R.1	G-23611	X.1
Bayer 8173	P/A.5	G-24480	P/H.5
Bayer 9010	X.2	GS-13332	X.7
Bayer 9026	X.3	Bayer H-321	X.3
Bayer 19639	P/A.7	HCH	C.1/2
Bayer 22408	P/H.2	HCN	F.3
Bayer 37344	X.3	HEOD	C.5
Bayer 39007	X.2	HHDN	C.4
Bayer 41831	P/C.7	Hoe 2671	C.6
Bayer 44646	X.4	Bayer L13/59	P/A.1
Bayer 21/199	P/H.1	L11/6	P/A.6
Bayer 22/190	P/C.6	MAPO	R.3
BHC	C.1/2	NC-262	P/A.10
gamma BHC	C.1/2	Niagara 5462	C.6
BIO-5462	C.6	R-1504	P/H.3
CL 38023	P/C.12	SD 3562	P/A.4
CP-14957	C.7	SD 4402	P/C.14
CS645A	D.4	SD 9129	P/A.3
DDD	D.2	Shell SD-4294	P/C.14
DDT	D.1	Sumitomo S-1102A	P/C.6
Dowco 139®	X.5	TDE	D.2
Dow ET-14	P/C.9	Velsicol 1068	C.3
Dow ET-57	P/C.9		
Bayer E-600	P/C.3	Compounds identified by number only	
Bayer E-601	P/C.1		
Bayer E-605	P/C.2	666	C.1/2
E-1059	P/A.5	1068	C.3
ENT 24650	P/A.10	1605	P/C.16
ENT 24970	P/H.2	4049	P/A.8
ENT 24915	R.1	7744	X.6
ENT 25726	X.3	Compound 118	C.4
ENT 25766	X.5	Compound 497	C.5

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* For names of individual species, see under Calliphoridae (Table 1, X, 5).

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* For names of individual species, see under Blattidae (Table 1, H,2).

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* Only those studies have been listed in which x-rays were used as a tool which did not directly affect the object under investigation. Due to the large number of pertinent references of the other kind, on the other hand, these have not been summarized here. The use of x-rays is, however, indicated throughout for each relevant study.

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